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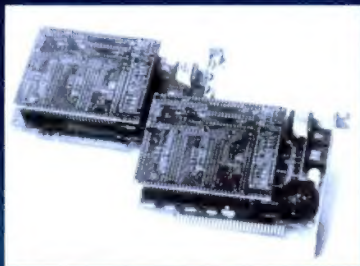
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CIRCLE 173 ON READER SERVICE CARD

Inside

There's no doubt that outfitting your 386 with a math coprocessor will improve the performance of your favorite CAD package. And, with some programs—AutoCAD, for example—a coprocessor is a prerequisite. But will a dedicated number cruncher speed up your spreadsheets? And if you decide you want a coprocessor, is there any reason to consider any of the alternatives to the industry-standard Intel 387? These are some of the questions PC Magazine Labs set out to answer when we began planning this issue's feature on math coprocessors.

"There's an awful lot of confusion among users," says contributing editor Winn L. Rosch, who wrote the article. "People think they're going to get better performance from a coprocessor in all their applications—and that's clearly wrong. Yes, a math coprocessor can be the cheapest speedup, but if your applications don't support a coprocessor, your money is wasted." A frequent contributor to *PC Magazine* since 1981 and author of *The Winn Rosch Hardware Bible* (Brady, 1989), Rosch got involved in the article because he "wanted to show our readers what a coprocessor will really do."

To sort reality from fantasy, we enlisted the help of Stephen W. Plain, a PC Labs system support specialist since 1988. Under the guidance of PC Labs technical director Robert W.



Kane, Plain set out to create an entirely new set of tests based on applications. The final result: a suite of six tests using five popular software packages—Lotus 1-2-3, Microsoft Excel, Quattro Pro, AutoCAD, and DesignCAD. We picked

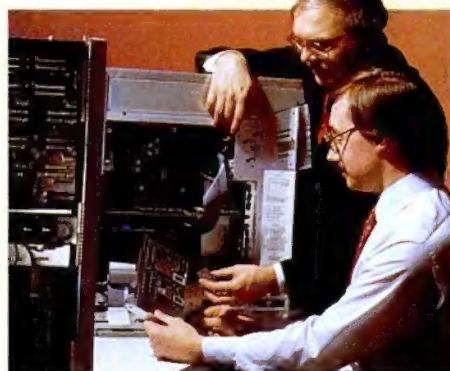
this application-based testing strategy, Plain explains, "to show how and to what degree a math coprocessor will benefit you in the most typical situations."

To augment the application-based tests he came up with, Plain then turned to the PC Labs

Benchmark Series, Release 5.6, for a test that would show how the components performed "in a vacuum." So, to discover their pure hardware power, Plain took each coprocessor and ran it through PC Labs' Floating-Point Calculation test. As you'll see in the story "Math Coprocessors: Fact or Fantasy," the two sets of tests yielded very different—and very interesting—results.

Our cover story this issue also promises some rather interesting results. PC Labs evaluates 30 machines based on the fastest PC platform in the world today: the 33-MHz 486. To see how these state-of-the-art screamers stack up against each other, and against all the tests our reviewers put them through, turn to "33-MHz 486 PCs: Maximum Performance" by contributing editor Jim Seymour.

—Mary Kathleen Flynn



Contributing editor Winn L. Rosch and PC Labs system support specialist Stephen W. Plain discovered the truth about math coprocessors.

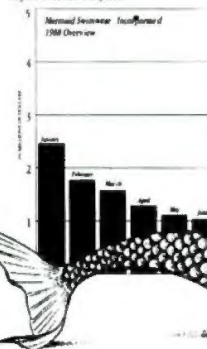
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Sales flounder early

To our shareholders:
Net income for MerMad Swimwear Incorporated in 1988 increased 4% from 1987.

Highlights of Operations
The premier performer was a new line of MerMad and MerKad swimwear designed by Karina Zapata, a world-renowned designer of women's sportswear. Test marketed in the Northeast territory was the MerMadjet swimwear line, proposed by my wife. The test was only moderately successful, and the line was pulled from stores two weeks after its introduction. The company realized a substantial boost in profits from Grosper's Undersea Adventures, a subsidiary company specializing in cruise/cuba diving vacations. The firm's president and head cruise director, Rick Grosper, reported income in this leisure activity is at an all-time high. He also noted that the business was not negatively affected when one of the firm's cruise ships, captained by a former crew member of an oil

tanker, ran aground and caused a huge frigate dolphin spill along the southern tip of Cuba.
Setting New Courses
In June of 1988 we acquired



Sales flounder early but surge in 2nd half

To our shareholders:
Net income for MerMad Swimwear Incorporated in 1988 increased 4% from 1987.

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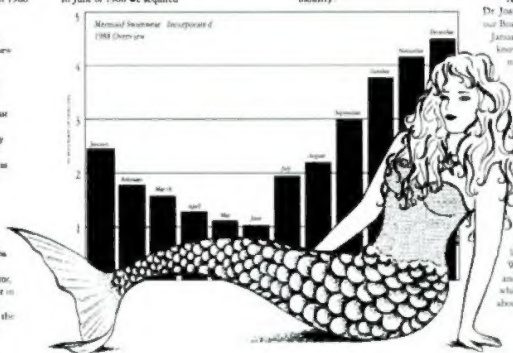
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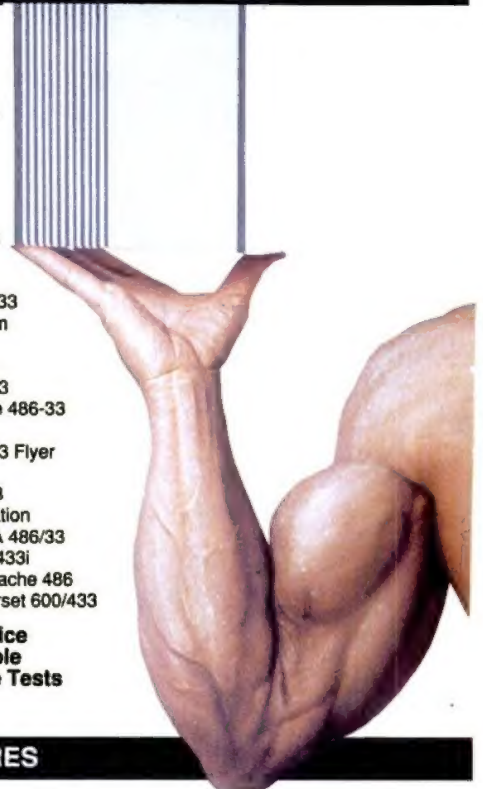
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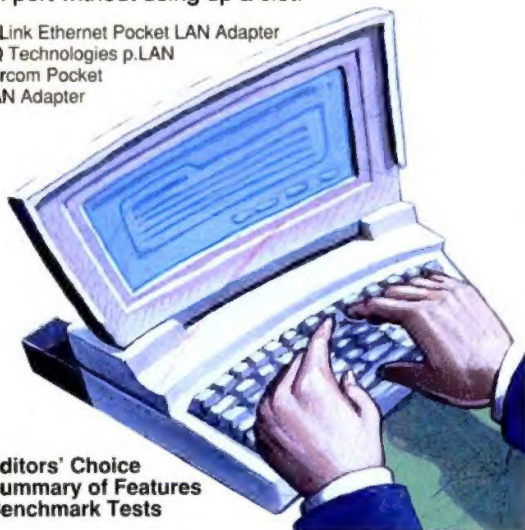


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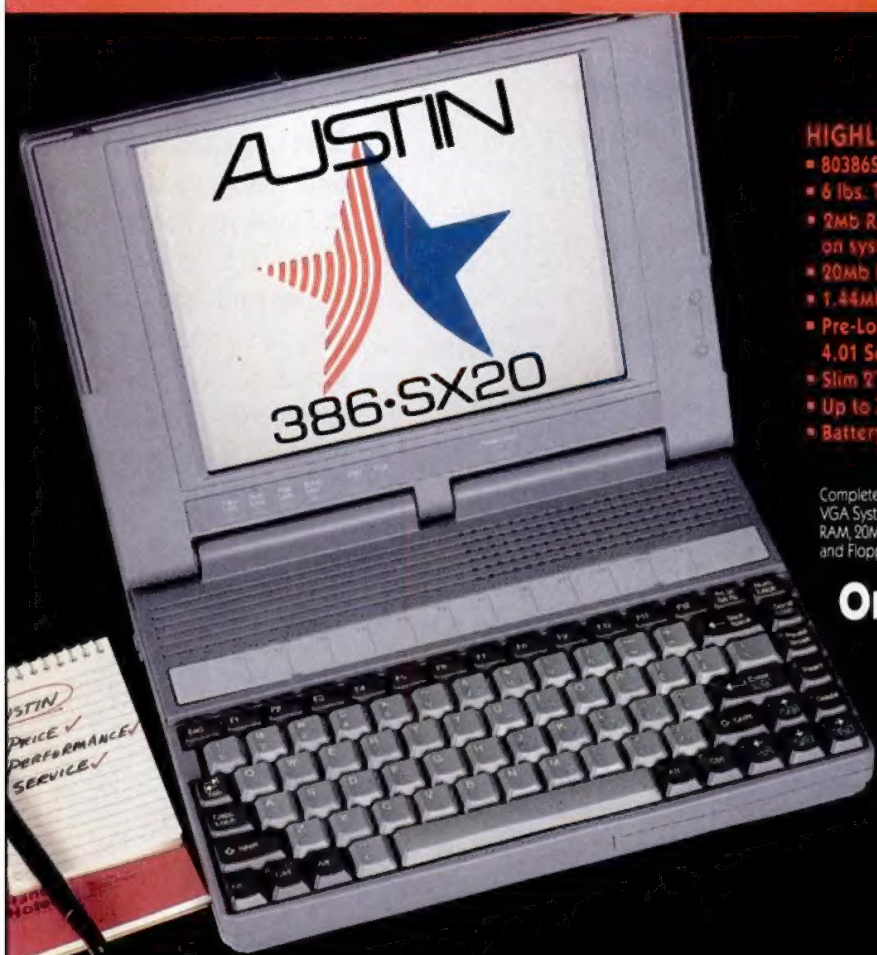
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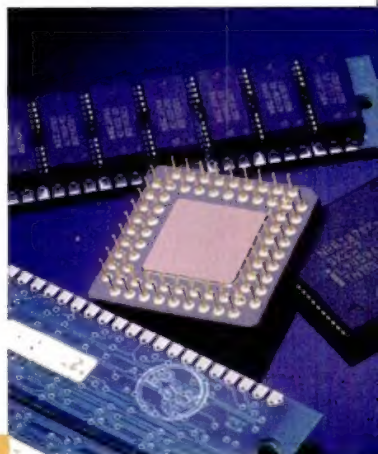
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HIGHLIGHTS

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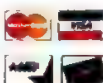
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HIGHLIGHTS

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AUSTIN 386/SX16 WINSTATION

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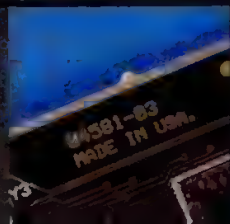
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In *PC Magazine's* 386/SX-20 Editor's Choice review, they said, "The Austin 386/SX-20 PowerStation narrowly missed this award (Editor's Choice) because the FCC had not yet granted it Class B status..." Well, guess what! We've got it now!



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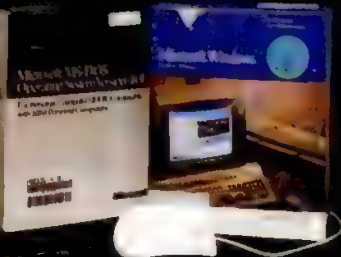
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Thanks to Print'N'Run, new Software Carousel is also an advanced print handler. One that quickly takes over your printing jobs by accepting all the output bound for the printer, then sending it to the printer as fast as it can take it.

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Even the experts agree.

Garry Ray, writing for PC Week, said, “Of these alternative operating environments (OS/2, DesqView and Software Carousel), Carousel may be the best choice of the day.”

Barry Simon of PC Magazine concurred with, “...I find it difficult to imagine using my computer without Carousel. This package has become an essential tool and one that I strongly recommend.”

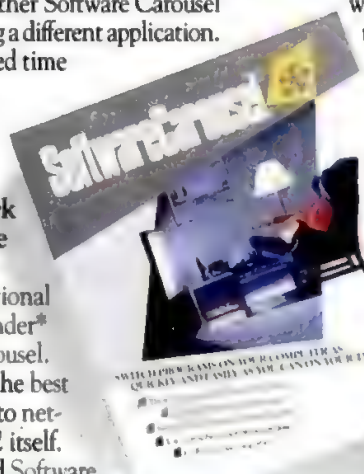
So if you really want the major benefits of Windows and OS/2, don't get grounded with high cost and mind-bending complexity.

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*Open Link Extender is sold separately. †Requires NetBIOS connection.

Letters

THE DEATH OF CODE

Until I read John C. Dvorak's "The Death of Code" in the November 13, 1990, issue, I had never—regardless of the magnitude of my emotion on any issue—felt the urge to take pen to paper and make my own feelings open to him, your staff, and readers.

Rarely have I encountered an issue so clearly defined as his review of the seemingly endless series of copyright infringement suits within the software industry. Though I have no professional vested interest in the outcome of such proceedings, I have an inherent distrust for those who feel it is possible to legislate the development of technology by effectively sanctioning the monopoly of a market. Many legislators seem to be entirely too fascinated with the technology of computers to make any objective decision as to the application of existing copyright laws in what is still a relatively new industry.

So thanks, John. I will be contacting the League for Programming Freedom as you suggested, as well as my congressman, should this preposterous situation ever get that far. Knowing our Congress, it probably will.

Harry G. Fleming
Tacoma, Washington

Just when I have written him off, Dvorak comes up with a piece that should be required reading for every person that uses computers or depends on their use—which includes almost everyone!

I'm referring to his November 13, 1990, column. I am not a programmer. However, this issue—the nature of what will be eligible for copyright or patent—is an issue that has very broad implications for the U.S. economy as well as for the rights of individuals.

All *PC Magazine* readers should become familiar with this issue and should make waves with their congressional representatives.

Mark E. Alsop
Brewster, New York



THE PS/1: THE VOLKSWAGEN OF COMPUTERS?

For once John Dvorak and Jim Seymour seem to agree about something vis-à-vis their respective reviews of the PS/1. They were both somewhat aghast by this latest marketing endeavor of Big Blue's. Needless to say, neither of these two esteemed market analysts predicted a very bright future for the PS/1. Notwithstanding this gloomy prospectus, their description of this new computer would have aptly summed up the Volkswagen Beetle during the late 1950s.

All things are relative, gentlemen. Computing is no longer the exclusive domain of the hard-bitten, demanding power user whose life's blood is measured in MIPS and megabytes. Technology is showing democratic tendencies. Most people don't wear out the print in computer magazines with their eyes from obsessive reading. They do, however, shop at Sears. The concept of a computer for Everyman is, in my opinion, a valid one.

But I can understand Mr. Dvorak and Mr. Seymour's position. I am sure they found themselves in a situation akin to that

of an editor for a biker magazine tasked to comment on and evaluate the virtues of a Harley-Davidson moped.

Robert Lively
Navarre, Florida

I would like to know why Dvorak and Seymour are constantly beating up on the PS/1. Besides their obvious dislike for IBM, what exactly is wrong with the PS/1 besides the moderately high price? Hey, what about Compaq? For a couple of guys who don't bat an eye at the idea of a \$5,000 laptop, their concern about the PS/1 is indeed a puzzlement.

Cheaper, faster clones exist in great numbers, but what if I need parts two years down the road? Where will the 20-year-old whiz kid entrepreneur CEO of Clones Ltd. be even six months from now? Look at any list of PC clone makers from 1988 or 1989. How many of these companies have disappeared, lock, stock, and warranty?

And where is it carved in stone that the 386 alone can stand the rigors of the real world? By the time people need 32-bit software at home to do useful work, the 80386 will be as much a dodo as the 8088/V20. In the meantime, the PS/1 will do nicely in most homes for now and for the readily foreseeable future.

Jim Nietopski
Williamsville, New York

THE HOME PC IS NO MYTH

Jim Seymour's October 30 column ("The 'Home-PC Market' Myth Rises Again") is the latest in a long litany of "expert opinions" purporting that there are no real uses for computers outside the workplace. This is incorrect. The usefulness of a home computer is limited only by the imagination of its user.

The home computer is a real and viable entity. Separately, it is only a sum of its software. It is a typewriter, a video game, a textbook, and a tape recorder. But collectively, it is much more. It is a magnificent tool for self expression and self discovery. Unfortunately, this aspect of the

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Letters

home computer is its most undervalued.

Perhaps the blame lies with IBM's growing hegemony over the microcomputer market. Business is IBM's middle name, and people take that too seriously. Perhaps because personal growth is something that can't be factored in on a spreadsheet, it is therefore dismissed.

Dan Mulhollen
Cleveland, Ohio

Jim Seymour's column overlooked the recent changes in the home-PC market. His view that the home PC is just for games and shopping lists is outdated.

I use my PC to help review the stock market, order merchandise, and check flight reservations (all through Prodigy). I use a word processor to prepare letters and have many utilities installed that I obtained through your magazine. I know many people who also use their computers for similar purposes.

Paul Grossberg
Phoenix, Arizona

With regard to your October 30, 1990, issue, I think Dvorak and Seymour are overestimating the impact of IBM and Tandy on the PC market as a whole, and particularly on the low end of the scale.

The majority of people who buy AT compatibles never read your magazine. They get sweaty palms and quivering lips if they even reach for an issue, because most of what's in it is Greek to them.

Even though the direct marketers are posting some impressive numbers, people have to buy a magazine to see their ads. I get blank stares from most people when I tell them I have a Zeos SX. If Tandys are confined to Radio Shack outlets, and the PS/1 mainly to Sears stores, they are up against competition from mall-oriented computer retailers offering competitive prices on "home-office" PCs, companies like Packard-Bell and Epson, whose television and Sunday paper advertising is formidable.

Who is going to buy a home PC when they can get a home-office PC for the same money or less? Most low-end computer buyers may not know their comm port from a hole in the ground, but they do know the value of a buck.

Keith Parkansky
Milwaukee, Wisconsin

I have been a computer professional for over 20 years, and a home-computer user for 8. My experience leads me to believe that Jim Seymour is confusing the office-at-home user with the home-computer user: in other words, business work versus personal work.

My entire family uses our three home computers: my sons play games and do

Software is *not* like hardware. When you buy software you don't actually own it unless you purchase the copyright.

their homework; my wife and I pay our bills, compute taxes, and handle correspondence. The key to our home-computer use is diversity: there is no single application that justifies owning a home computer.

I don't really care that my taxes would be completed much faster if I had a 486; my four-year-old Compaq (slower than a PS/1) is just fine. I'm already saving days over what it would take to do it by hand. Besides, at home, I can always talk to my family while my "slow" computer grinds away.

By my definition of home computing, the PS/1 would do very nicely, thank you.

William Huebsch
New York, New York

WHO PAYS TO REPLACE SOFTWARE?

Regarding Bill Machrone's July 1990 editorial ("Software Up in Flames") about replacing software and Mitch Barrie's response (*Letters*, November 13, 1990) comparing a software purchase to buying a car: Mr. Barrie misses the point. Software is *not* like hardware. When you buy software you don't actually own it unless you purchase the copyright.

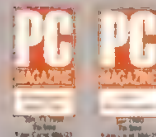
When the disks are destroyed in a fire you still retain your registration as a product user, the right to product support, and the right to upgrade at a reasonable price. I don't think that it is unreasonable to

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- Suspend Mode To Halt And Later Resume Work
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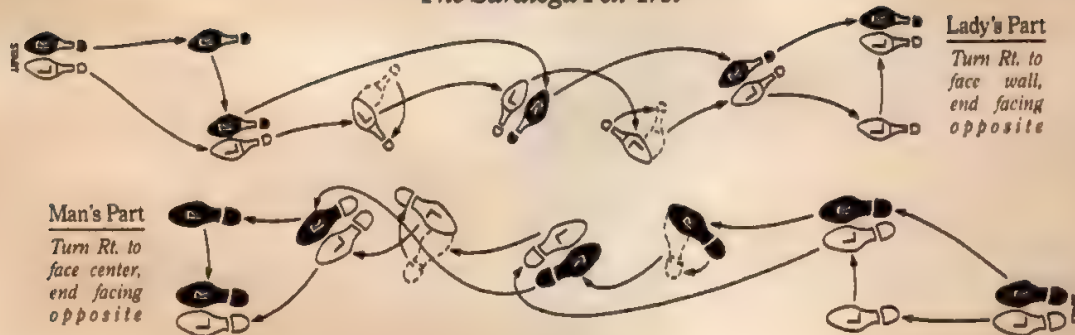
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Letters

expect, as part of product support, that the disks and documentation be replaced at a discounted price.

I wonder what Mr. Barrie would do if he lost the owner's manual to his car?

David Plaut

Reisterstown, Maryland

Are you guys nuts? In reference to the various letters about replacing software that was burned or in some other way

**Windows is pretty,
but it sure has a nasty
personality. But hey,
for the 35 bucks I
spent, you couldn't get
a better solitaire game.**

destroyed, has anyone considered getting insurance?

Computer insurance is very inexpensive (mine covers any software problem). So what—the house burns down along with *Lotus 1-2-3*. Contact your insurance company and you'll get a new one without a dime spent.

Gary L. Skinner

Providence, Rhode Island

IBM'S TRUE INTENTIONS

Concerning Dvorak's October 30, 1990, column, "IBM's True Intentions," does he hate IBM, or just any large corporation?

Some of IBM's sins include: "a big push . . . through a direct and continuous sales promotion," "an easy-to-use plug-and-run low end machine priced under \$1,000," "idiot-proof software," an expectation of prices to fall, and more. Since nothing he admonishes IBM for appears to be illegal, Dvorak seems to be accusing IBM of being guilty of practicing the free enterprise system (that is, capitalism).

What an interesting nineties concept!

Edward C. Mack

St. Clairsville, Ohio

DOS: IS IT THE OPERATING SYSTEM OF THE FUTURE?

As an avid reader of *PC Magazine* for many years, I was excited to read what has to be one of the most important articles published in any computer journal in the past few years. I refer to Ray Duncan's "A Prescription for the Operating System of the Future" (October 30, 1990). Unfortunately, this thoughtful, cogent piece was published under the Power Programming column, a place that, I fear, will cause its message to be missed by many readers.

In short, Mr. Duncan has laid out a logical, detailed plan for transfiguring DOS (yes, plain old DOS) into the operating system that millions of users would gladly pay good money to own: intelligent, fast, configurable, compatible.

Are you listening, Bill Gates? If Microsoft has the common sense to work on DOS as Mr. Duncan suggests, I and many others would gladly pay for it.

Lloyd W. Black

Haddonfield, New Jersey

PRETTY WINDOWS

Microsoft Windows 3.0 is pretty, but it sure has a nasty personality. It follows few standards for protected-mode programs, is very slow, is very inefficient, and is practically useless unless you run tons of Windows software.

But hey, for the 35 bucks I spent, you couldn't get a better solitaire game.

Michael D. Lore

Houston, Texas

CORRECTIONS & AMPLIFICATIONS

In the Advisor column (October 30, 1990) we should have stated that *Multibase 3* is the networkable version, while *Multibase 2*, Version 3.2 (\$649) supports multiple engines and servers. Also, the correct number for Cykic Software is (619) 297-0182. In addition, Sophco, which sells *Force*, is located at 4730 Walnut, Bldg. B, Boulder, CO 80301; (303) 444-1542.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments, complaints, insights, and suggestions. Please send them to Letters, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 8 for access information). All letters become the property of *PC Magazine* and are subject to editing.

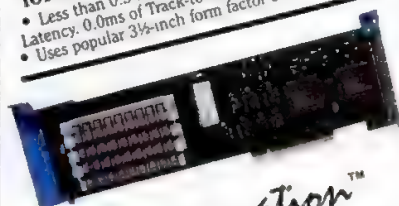
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Software Digest Rating	Overall Evaluation	Overall Power	Program Name	Version Tested	Performance	Usability	Error Handling	Ease of Learning	Ease of Use	Memory Requirement	Price	Volume Purchase Agreement	Page
***	70	67	dBase IV	11	■	■	■	■	■	450KB	\$795	✓	28
**	6.8	51	Paradox	3.5	■	■	■	■	■	640KB	\$995	✓	32
**	6.8	71	FoxPro/LAN	102	■	■	■	■	■	512KB	\$1,095	✓	30
**	6.4	51	DataEase	4.2	■	■	■	■	■	640KB	\$750	✓	26
*	5.8	3.6	R:Base	3.0	■	■	■	■	■	520KB	\$995	✓	34
*	5.7	6.0	Clarion Professional Developer	21	■	■	■	■	■	512KB	\$845	✓	24
*	5.7	6.6	Advanced Revelation	2.01	■	■	■	■	■	640KB	\$985	✓	22

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by
Gus Venditto

Advisor

DECIDING BETWEEN A V.22BIS OR V.42BIS MODEM

Please explain the different modem protocols, such as V.22bis, V.32bis, V.42bis and the MNP error controls. I need to know what I would miss if I bought an \$89 2,400-bit-per-second external modem with only V.22bis. Would it be worth spending an extra \$50 for one with V.42bis?

Michael J. McCollister
Orlando, Florida



If you are able to purchase V.42bis for only \$50 more, you're getting a real bargain. It often carries an \$80 or \$100 premium.

The V.42bis standard is worth \$50 or \$100, since it provides several forms of intelligence for getting faster transmissions with fewer hassles. And that will mean lower phone bills. The only reason you might not want V.42bis is if you have a limited circle of correspondents and none of them plan to use it.

There are two basic ways that a V.42bis modem at 2,400 bps will be better than a V.22 modem at the same speed.

The first is error correction. When you use a software protocol like Xmodem to monitor the size of a data block that's sent, you're using software error correction. A V.42bis modem includes a hardware form of error correction that's known as V.42 (without the bis). A modem with V.42 will automatically ensure that the data being transmitted arrives virtually error-free if it's connected to another modem with any of these forms of error correction: V.42, V.42bis, or MNP4 (Microcom's Networking Protocol Class 4).

Error correction is a lifesaver whenever you need to cope with noisy phone lines, since any time a packet of information is distorted by static, the two modems know that the data needs to be re-sent and they'll continue re-sending until it arrives in good shape. When done in hardware, the detection and correction of errors is much faster than when done with its software counterpart.

■ **DECIDING BETWEEN A V.22BIS OR V.42BIS MODEM:** How to choose among modems that offer hardware error correction and data compression.

■ **BAR CODE TOOLS:** How to start building an inventory tracking system.

■ **PROGRAMMING WITH .TIF FILES:** Learning to write code that reads gray-scale images.

The next major benefit of a V.42bis modem is data compression. The sending modem uses an algorithm to compress the file that will be understood by the receiving modem. Since fewer bits end up being transmitted, it takes less time, and the user doesn't need to do any extra work. It's as though your files were run through an archiving program like *PKZIP* or *ARC* before they were sent.

The two modems will recognize this capability in each other; if a V.42bis modem finds V.42 at the other end, it will use error correction without compression. If it finds a V.22bis modem, it will send and receive according to the V.22bis standard (ie., at 2,400 bps without correction or compression).

The V.32 standard is becoming limited to the sort of direct communications that a company might set up between branches and headquarters to transfer huge data files. It is used to control 9,600-bps communications (with fallback to 4,800 bps) and uses an uncommon method of flow control called trellis-encoded modulation. It hasn't been supported by public networks and so, if you don't need it to communicate with a specific site, you'd be making a mistake to buy it since a V.32

modem usually costs several hundred dollars more than a V.42bis modem.

You may decide that V.42 or MNP4 alone is all you need, but V.42bis is certain to become popular, especially now that Hayes has added the feature to its line after ignoring it for years. CompuServe plans to add both V.42 and V.42bis in coming months, and many of the private bulletin boards are using at least one of the three already.

After shopping around, you may raise another question: V.42bis or MNP5? This is a tougher decision. The two are competing data compression standards and they don't understand each other.

If your immediate circle of communicators use MNP5, you may want to go with that, but the momentum is with V.42bis and it's probably the one you'll be happier with in the long run.

Since both MNP5 and V.42bis work with both MNP4 and V.42 modems on error correction, either choice will be better than a plain V.22 modem.

Modems that have both MNP5 and V.42bis give you the greatest level of compatibility, making them the best buy of all.

BAR CODE TOOLS

I'm a programmer/analyst at Maytown Shoe Manufacturing, working on a project for tracking our work in process.

We would like to input a great volume of data quickly by using bar-coded tickets but we can't find the necessary software/hardware tools.

Dean Rose
Altoona, Pennsylvania



Without knowing the specifics of the languages you're using and the PCs you have on hand, the best I can do is give you the names of several companies that sell a broad range of bar code readers and the software needed to use them with a PC.

Before you call, you should understand the basic offerings. Bar code read-

Advisor

ers cost anywhere from \$400 to \$2,000; you'll have the choice of buying one that plugs into a serial port or keyboard so you should decide early on which will work best for you (a serial input gives you more flexibility in using the bar code reader but may require more programming).

The reader can easily be used to insert its characters directly into a DOS application; you shouldn't need to do much programming to create an application that takes bar code input.

It will be a little trickier to create your bar code labels. Most of the companies in the business sell software that prints bar codes on labels in standard PC printers. It sounds like you'll want printing software that correctly interprets inventory information from your application. Some of the available programs are memory-resident and accept control characters from the underlying application in creating the bar code.

Here are a few of the many suppliers. You may find the best system is created

by using one company's printing software and another's reader.

Percon in Eugene, Oreg.; 503-344-1189.

International Technologies & Systems

**Modems that have
both MNP5 and
V.42bis are the
best buy of all.**

Corp. in Brea, Calif.; 714-990-1880.

Time-Keeping Systems Inc. in Cleveland, Ohio; 216-361-9995.

Worthington Data Solutions in Santa Cruz, Calif.; 408-458-9938.

Bear Rock in Diamond Springs, Calif.; 916-622-4640.

Computer Connection in Eau Claire, Wis.; 715-833-2331.

BTC Corp. in Fremont, Calif.; 415-657-3956.

TPS Electronics in Palo Alto, Calif.; 415-856-6833.

American Microsystems in Euless, Tex.; 817-571-9015.

PROGRAMMING WITH .TIF FILES

I'm writing software that needs to read gray-scale .TIF (tagged image format) files. Could you supply any information about using the format?

Joe Robinson
Friendswood, Texas



The easiest thing for you to do is to buy one of the libraries available for reading .TIF files. Victor Image Processing sells one for \$175 and Sun Country sells one for \$219. Both are available through Programmers Connection in North Canton, Ohio; 800-336-1166.

ASK THE ADVISOR

Send your questions to PC Advisor, One Park Avenue, New York, NY 10016 or upload them to PC MagNet (see the instructions for joining on page 8 of this issue). Sorry, but personal replies are not possible. ■

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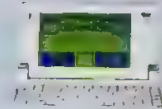
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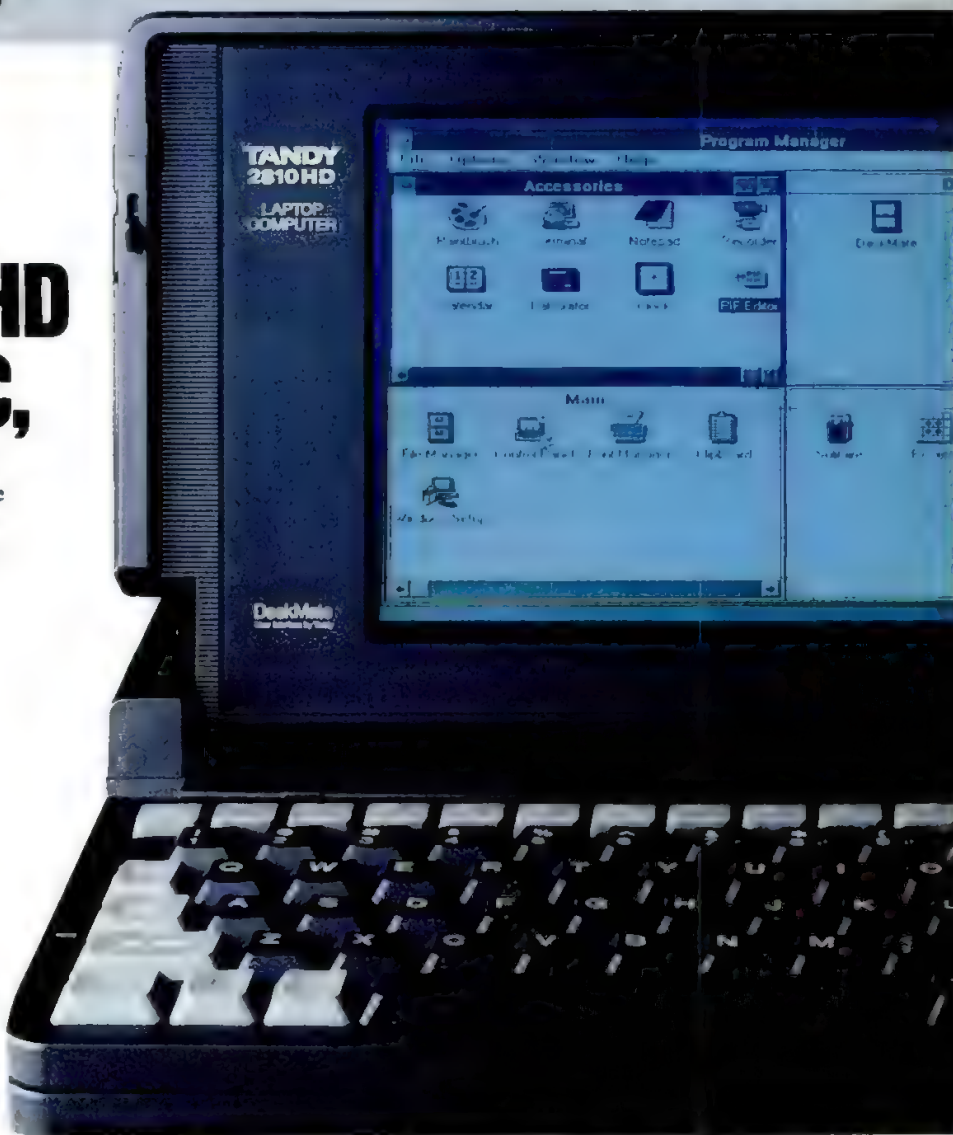
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CIRCLE 165 ON READER SERVICE CARD

First Looks

Hands-On Reviews of the Latest Products

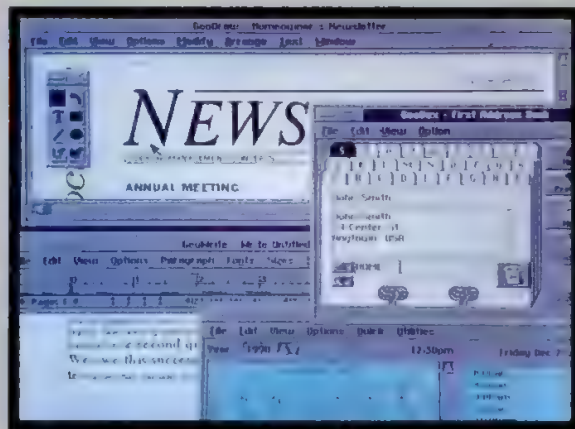
GeoWorks Ensemble Lays the Foundation For A Brave New OS

HANDS ON
by Mitt Jones

If you number yourself among the *Windows* cynics in the crowd—those who insist that Microsoft could have done a good bit better—you'll find reassuring support in the form of *GeoWorks Ensemble*. It's not that PC/GEOS—the graphical user interface (GUI) behind the \$199.99 *Ensemble*—is perfect, or that *Windows 3.0* isn't better in some respects. *GeoWorks* has simply produced a more-innovative, more-efficient, better-looking GUI.

More important, perhaps, it has produced a GUI capable of making the PC a more friendly and powerful creature to the millions of people *Windows* and *OS/2* have left behind—those using 8088-, 8086-, and 80286-based machines.

PC/GEOS first came to public notice during a spat between



GeoWorks Ensemble's seven applications include word processing, drawing, and communications modules.

Microsoft and IBM well over a year ago. *GeoWorks*, then Berkeley Softworks, was working with IBM to develop "PM Lite"—a GUI that would run over DOS, but look much like

Presentation Manager.

The trouble reportedly began when Microsoft learned of the project. Fearing that PM Lite would threaten its substantial investment in *Windows*,



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Microsoft lobbied for abandonment of the product. IBM eventually acquiesced. Berkeley finished the project on its own.

Gates and company at Microsoft are not likely losing sleep over this now that IBM is no longer explicitly involved (IBM uses a runtime version of PC/GEOS as a portion of the

CONTINUES ON PAGE 30

Northgate, Icon Feature Edsun Continuous Edge Graphics

PREVIEW
by Matthew J. Ross

Edsun Laboratories' Continuous Edge Graphics (CEG) has been making news since it was first announced more than a year ago, well before there were any products to demonstrate its prowess. Now, the Edsun RAMDAC digital to analog converter—designed to significantly improve your video performance—is available in two shipping products: The Icon Photo Board, a \$475 16-bit Super VGA adapter, and the Northgate SlimLine 386/33.

The Edsun chip transforms jagged VGA output to smoother

CEG images through anti-aliasing—manipulating the color of pixels at the edges of shapes and objects. It effectively increases the perceived level of resolution on a monitor by displaying 740,000 simultaneous colors at 8-bit-per-pixel level, as opposed to the 256 color limit on standard Super VGA adapters. (See sidebar "Inside Edsun's CEG/DAC.")

The Icon Photo Board evaluated in PC Labs is a 16-bit card built around the popular Tseng Labs ET4000 VGA graphics controller. The Photo Board ships with 1MB of dynamic video memory for 256 color support at Super VGA resolutions.

As tested it featured CEG drivers for *Lotus Symphony* and *Lotus 1-2-3*, Release 2.x, a CEG display list driver (DLD) for *AutoCAD* from Panacea Computer Graphics Software, and Edsun utilities including a Targa-to-CEG image file-conversion utility. Northgate provided the same drivers with its system. Icon and Northgate will have a 16-color *Windows 3.0* CEG driver available by March 1, 1991, to more fully exploit Edsun's CEG.

Both the Northgate SlimLine 386/33 and the Icon Photo Board feature the first iteration of the Edsun RAMDAC, whose operation is limited to 55 MHz. At this speed, the output signal supports 1,024 resolution on interlaced monitors only. The

horizontal scan rate is not fast enough to drive 1,024-by-768 noninterlaced resolution.

The continuous edge graphics more than made up for the 8-by-6 resolution limit set by the speed of the Edsun chip. Used with an NEC MultiSync 3D monitor, the Icon Photo Board's video performance under *AutoCAD* was stunning, comparable to high-end proprietary systems. At both VGA and 800-by-600 resolutions, arcs were smooth, and lines and edges were precise, making this \$475 adapter a worthy competitor of dedicated graphics workstations.

In addition to the CEG drivers, the Icon Photo Board has its own drivers, supporting up to

CONTINUES ON PAGE 35

First Looks

GeoWorks

CONTINUED FROM PAGE 29

PS/1 interface). *Windows 3.0* has caught on big, and Microsoft's clout makes it unlikely that *Windows* will lose ground to an unknown quantity.

But PC/GEOS makes *Windows* look decidedly bad in some respects, and makes OS/2 seem a bit bloated and hardware-hungry. The system employs an OS/Motif-compliant interface, which works much like the *Windows* interface but is more attractive and more powerful. The assembler code behind the interface is fast and lean, includes a PostScript-like imaging system, and supports a high-level hierarchy of object-oriented routines as well as OS/2-like preemptive multitasking and multithreading. Combine all of these attributes, and you have what seems just short of a miracle: a sophisticated, multitasking GUI capable of running in real mode on an XT with 512K RAM.

Although no formal Software Developers Kit (SDK) exists yet, GeoWorks reports that it has already accepted 150 software vendors into the beta-test program for its PC/GEOS SDK. Lotus is rumored to be working on a PC/GEOS version of 1-2-3, but it will take at least a year and a half or so for significant third-party applications to become available. In the meantime, *GeoWorks Ensemble* provides a suite of applications as well as hooks to DOS that should keep entry-level buyers busy.

Getting started with *Ensemble* is a cinch, thanks to a well-done Quick Start booklet and a *Windows*-like automatic installation routine. When you boot the program, the first thing you see is an attractive Welcome screen, which features three large, illustrated buttons—one that invokes the Appliances workspace, an area meant for novices; another that leads to the professional workspace; and a third that provides access to DOS programs.

The Appliances workspace provides simple, foolproof ver-

sions of a calculator, address book, calendar/planner, notepad, banner printer, and—you guessed it—Solitaire game. The first four are bare-bones versions of the corresponding desktop tools in the Professional workspace.

Once you've mastered the Appliances section you'll want to try the more-powerful applications in the Professional workspace. Any data you enter into the Appliances section is carried over into the Professional versions of the utilities.

If you've used *Windows*, you'll feel at home within the Professional workspace. It uses the same type of menu bar, window movement, sizing, and scrolling controls. You'll also find a much more-attractive screen, a few new features, and a difference in organization.

PC/GEOS's good looks come from its extensive use of 3-D effects and colorful icons. Perhaps the most useful new feature is the ability to "pin" open (tear off) any menu and move it about the screen as you would any window. Another useful addition is the Express button. The Express menu lets you toggle between open GEOS applications, start a new GEOS application, or exit to DOS.

Ensemble's fundamental departure from *Windows* should be a welcome one, but it can be confusing. *Windows 3.0* boots under the Program Manager. The Professional workspace starts up under its file manager,



FACT FILE

GeoWorks Ensemble

GeoWorks, 2150 Shattuck Ave., Berkeley, CA 94704; 415-644-0883.

List Price: \$199.95.

Requires: 512K RAM; hard disk; mouse; Hercules, CGA, EGA, VGA, or MCGA graphics.

In Short: A suite of entry-level applications paired with the promising PC/GEOS environment, *GeoWorks Ensemble* brings the conveniences of a powerful graphical user interface to users of XT and AT machines.

CIRCLE 702 ON READER SERVICE CARD

GeoManager. And while *Windows* spreads the icons for its utilities and applications across several logical groups, the Professional workspace gathers its program icons into one subdirectory called World, the default directory under *GeoManager*.

The advantage of this is that the World screen holds all GEOS program icons and serves as a central point of reference. The disadvantage concerns the enigmatic relationship of *GeoManager* and the World view. Novices will be a bit confused as to how World can be the central screen but can appear only when run under *GeoManager*, and why *GeoManager* is shown in the World view as an icon when it must already be running to display the World view. A neater solution would have been to have the World

view running independently and above the *GeoManager*.

GeoManager makes even greater use of icons than *Windows* does, and adds a few nice capabilities that *Windows's* File Manager lacks. To select files or subdirectories from the large folder, you can click on the appropriate file icons or surround them with a rubber-banding box. To add a file or group of files to those already selected, hold down the Ctrl key as you make your selection. PC/GEOS also provides a trash can icon at the bottom left corner of the screen for quick file deletion. Unfortunately, the program provides no Undelete feature.

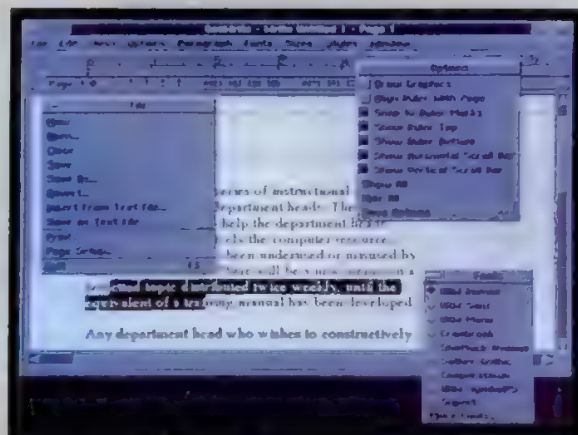
Taken as a whole, the applications and tools offered throughout the Professional workspace resemble *Windows's* in intended function but rise far above them in utility. *Ensemble* is ahead on looks and layout alone—the cardfile looks like a cardfile, the calendar allows side-by-side display of the month and day views, and the word processor sports a sophisticated ruler, complete with icons or sliding controls for paragraph alignment, tabs, indents, margins, and spacing.

PC/GEOS's preemptive multithreading capability also gives it a few advantages. Most of the applications can work with multiple documents. You'll also find other useful features, such as the ability to search the calendar/planner for text you've highlighted in the cardfile or the ability to search the cardfile from the calendar to call up a phone number and initiate autodialing.

Predictably, *Ensemble's* performance begins to suffer when several applications are running at once. While this is no trivial matter on an already-slow XT, multitasking slowly on an XT is preferable to not multitasking at all.

The most widespread advantages of *Ensemble's* applications over *Windows's* Accessories derive from PC/GEOS's WYSIWYG, PostScript-like imaging model. Throughout the applications, particularly in the word processor and draw program, you'll find great flexibility

CONTINUES ON PAGE 36



Tear off menus, scalable fonts, and a PostScript-like imaging model are hallmarks of PC/GEOS apps.

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Daniel Morgan, PC Magazine, 9/25/90

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PC Magazine, 9/11/90

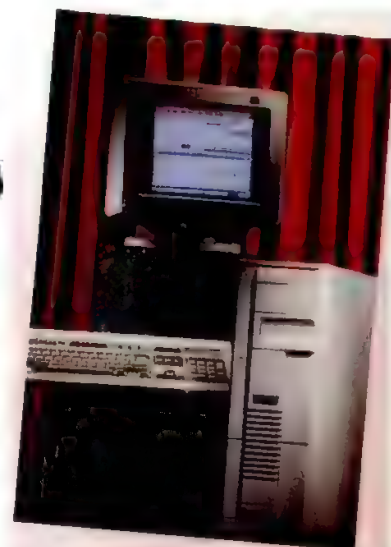


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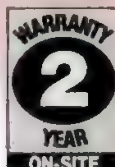
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First Looks

Edsun CEG

CONTINUED FROM PAGE 29

1,024 by 768 lines of resolution with 256 simultaneous colors for *Windows 3.0*, *AutoCAD*, and the *GEM* interface.

The Northgate SlimLine 383/33 is a small footprint unit measuring 16.5 by 16.5 by 4.25 inches. This compact, highly integrated PC holds eight 1MB SIMMs on the motherboard. Other built-in functionality includes the I/O (a parallel and two serial ports) and Super VGA video. The video graphics controller is an ATI 28800 with 512K video memory. A 14-inch multiscanning Panasonic monitor completes the package.

As tested, the Northgate SlimLine, with its ATI Technologies VGA chip coupled with the Edsun RAMDAC, demonstrates the same breathtaking video performance as the Icon Photo Board. The aggressively priced \$3,349 33-MHz 386 contains a full complement of equipment: three half-height

drive bays, a 40MB MiniScribe IDE hard disk, and two high-density floppy disk drives. Its expansion bus tree horizontally holds three 16-bit add-in boards on one side (two full-length), and two half-length, 8-bit cards on the other. Internal expansion is reasonable for a small footprint machine; it had no trouble holding an 80MB Plus Hard-Card II in one of its 16-bit slots.

At the time of this review, Northgate's production of systems with the Edsun chip had just begun. As a result, limited quantities of the SlimLine 386/33 with CEG will be available beginning in February, with quantity production not occurring until the spring. Northgate intends to feature the Edsun chip in all its systems, once quantities permit.

Both manufacturers intend to replace the 50-MHz RAMDAC with a 66-MHz version to support noninterlaced 1,024-by-768 resolution beginning April 1, 1991. When these and other Edsun-enhanced graphics products from Epson, Ergo, Monolithic, Orchid Technologies, and Trident Systems hit



Edsun's CEG enhancements (right) are visible in this before and after shot on the Northgate SlimLine 386/33.

the market in quantity, plain-vanilla VGA will soon be as dated as CGA and the dinosaur.

List Price: Icon Photo Board, \$475 with 1MB RAM standard. Icon Technologies Intl., 317 Varsity Park, Ste. 8, 15th St. NW, Charlottesville, VA 22903; 804-977-1551.

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List Price: Northgate SlimLine 386/33, with 4MB RAM, 40MB

IDE hard disk, 1,024-by-768 resolution Panasonic Super VGA monitor, 5.25- and 3.5-inch floppy disk drives, *Windows 3.0*, Microsoft serial mouse, DOS 4.01, \$3,349; 100MB hard disk, \$300 upgrade, 200MB hard disk, \$600 upgrade. Northgate Computer Systems, 7075 Flying Cloud Dr., Eden Prairie, MN 55344; 800-548-1993.

CIRCLE 703 ON READER SERVICE CARD

INSIDE EDSUN'S CEG/DAC

The CEG/DAC (Continuous Edge Graphics/Digital to Analog Converter) replaces the RAMDAC chip standard on all VGA boards. A RAMDAC extracts the pixels that software puts in VGA memory, and translates them into analog monitor signals. The DAC portion takes the digital pixel values—integers ranging from 0 to 15—and converts them to three analog (variable, noninteger) voltage levels, corresponding to the monitor's red, green, and blue guns. The RAM portion stores the translation tables necessary for this operation.

The CEG chip is pin compatible with industry standard RAMDACs, used in virtually all VGA subsystems. If your system (or board) has a socketed RAMDAC, you can theoretically replace it with the CEG chip. But there's no con-

venient way yet for an end user to secure the Edsun chip.

The smarts for the CEG/DAC come from an on-board DSP chip that handles the algorithmic processing. In its extended modes, initiated from a sequence of commands from special software drivers, Edsun's CEG/DAC can provide edge smoothing and make use of more colors. The edge smoothing is accomplished via a technique known as antialiasing. On a normal display, lines and fonts will appear to have "jaggies." The jagged appearance (aliasing) is caused by the granularity (chunkiness) of pixels on typical graphics displays. Higher-resolution display modes will decrease the amount of aliasing because these displays cram more information into less space.

Antialiasing has tradition-

ally been a software-only solution, minimizing pixel "chunkiness" by varying the intensities of pixels adjacent to the object edge. Seen from a normal viewing distance, antialiased objects appear to be quite smooth and give the illusion of much higher resolution. The software-only approach is limited to working with black or white objects and backgrounds because of the color limitations of standard graphics devices.

The CEG chip bypasses this color limitation by manipulating the analog color output to perform the antialiasing. The CEG chip gets its cues on how to perform the antialiasing or blending from application specific software drivers.

When the application wants to draw a line, the driver generates the line as requested, but it also adds special blending cues that tell the CEG chip in what ratio to mix the background and

object colors. The CEG chip can use either 16 or 32 levels of blending.

The drivers add some overhead, thereby decreasing graphics drawing performance by about 10 to 20 percent, according to Edsun Laboratories. If performance is critical, you can use the CEG chip in its compatibility mode with non-CEG based drivers. In this environment, performance will be up to full speed, but the "jaggies" will reappear. With the proper software, the CEG/DAC can be used on 8514/A- and TIGA-based boards in addition to the currently supported VGA and Super VGA platforms.

Right now, adding the CEG chip to a system or board increases the cost from \$15 to \$60. On the other hand, a higher-end graphics board with similar color blending capabilities would cost anywhere from \$600 to \$4,000.—**Jake Richter**

First Looks

GeoWorks

CONTINUED FROM PAGE 30
ty with fonts and graphics.

More importantly, the imaging model is device-independent—if your printer is among the 300 or so supported by *Ensemble*, you'll be able to print any of the package's nine .URW-based outline fonts in any size from 4 points to 792 (one character per page), and at any angle. You can also scale and rotate graphics and print in color.

Ensemble's applications maintain an object-oriented approach, giving the package a consistency that *Windows 3.0* lacks. Whether you're changing the color of a graphic in the draw program, applying a half-tone to text in the word processor, or searching the planner for a text string from the cardfile, you choose the object to be acted upon, then specify the action.

Like that of *Windows*, the *Ensemble* clipboard accepts only one object at a time, but *GeoWorks* built in a Scrapbook that provides a means for storing, viewing, and managing oft-used images and blocks of text.

Were it not for a glaring omission, *Ensemble* would be hard to beat as an easy-to-use, entry-level integrated package. The major component you won't find is a spreadsheet/database, and *GeoWorks* plans to have one within the year.

Other omissions detract, but don't completely spoil the applications. For instance, the word processor includes welcome features such as snaking text columns, automatic headers and footers, and the ability to import graphics and apply shadings and borders to blocks of text. It also supports variable leading. But it omits a spell-checker and search-and-replace capability.

The program includes two communications programs. One is dedicated to America Online, a graphics-based service still in the beta-testing phase for PCs. The other resembles the communications package in *Windows*, including its

support for the Xmodem protocol. *GeoComm* provides a competent script language, a feature *Windows's* Terminal lacks, but the script language is too intimidating for most novices. A simple list for oft-called numbers should have been included.

An especially serious fault, and one that seems somewhat ironic given *GEOS's* imaging system, is its omission of a PostScript printer driver. Try as we might, we also could not coax the system into printing to a file. *GeoWorks* reports that the PostScript driver, spell-checker, and search-and-replace feature are in the works and will be sent, free of charge, to current owners of the package.

The most frustrating deficiency of PC/GEOS, especially when compared to *Windows 3.0*, is its inability to work with more than one DOS program at a time. Even in Real Mode—the only mode in which PC/GEOS runs—*Windows* supports task switching between DOS applications, albeit slowly. Running

in 386 Enhanced Mode, *Windows* is capable of multitasking DOS applications.

Ensemble's DOS Programs area makes it easy to set up attractive buttons for each of your DOS applications, and even provides a batch file editor, but the environment doesn't support any task switching. It simply unloads itself from memory, waits for you to finish working with your DOS program, then gives you the option of re-entering *Ensemble* or exiting all the way to DOS. And *Ensemble* apparently falls a bit short of well-behaved—it simply wouldn't run under *Windows 3.0*, even in 386 Enhanced Mode. Interestingly, *Windows 3.0* will run in Real Mode from *Ensemble's* DOS Programs area.

Other advantages of *Windows* over *Ensemble*, aside from those having to do with its ability to support Protected and 386 Enhanced modes, include its macro recorder, the flexibility it provides in the creation and editing of program groups, and

its extensive on-line help.

If you only focus on the current success of *Windows*, the indomitable influence of Microsoft, and the difficulty already posed to software vendors by having to develop applications for multiple environments, it's difficult to believe that PC/GEOS will make any long-lasting impression.

From a different perspective, however, PC/GEOS has a pretty good shot. Hardware and software companies alike are increasingly realizing that the neglected low end of the PC market—not to mention the potential buyers who haven't found a user-friendly PC they're willing to spend their money on—constitutes an extremely lucrative and open market. In this context, a lean, powerful graphical user interface is an environment to be nurtured, not ignored. And even if PC/GEOS is doomed, *GeoWorks Ensemble* stands on its own as a powerful, reasonably priced, low-end productivity package. ■

IQ's SuperCartridge: One Stop Shopping for the LaserJet III

HANDS ON
by Edward Mendelson

It's no surprise that the best scalable font cartridge for the LaserJet III is from the company that makes the best bitmap font cartridges for earlier LaserJets. IQ Engineering's \$599 SuperCartridge 3/Professional Edition (SuperCartridge 3PE) contains 35 scalable typeface outlines to supplement the 8 CG Times and Univers outlines built into the LaserJet III.

The outlines in the cartridge include scalable fixed-width fonts and proportional fonts. All fonts print at the LaserJet's full speed—typically faster than any desktop PostScript printer or plug-in PostScript cartridge. The IQ doesn't require any extra RAM for the printer, either.

When added to the printer's outlines, IQ users have the equivalent of the 35 standard fonts in a PostScript printer plus scalable versions of Garamond and Prestige Elite (in four styles

each), scalable line-drawing characters, and an Old-English "Blackletter" font. The IQ fonts have larger symbol sets than PostScript fonts—including the otherwise hard to find slashed zero—but the character widths are different.

The scalable Courier and Prestige Elite faces are ideal for spreadsheet printing. The fixed-width faces are readable at sizes down to 3 points and smaller, but can also be printed at sizes up to 999.75 points. IQ avoids one headache of other proportional fonts by providing typewriter-style 6-lines-per-inch Prestige without making you adjust point size and line spacing within your application.

The cartridge's proportional faces include standard designs thinly disguised as "Avgard Gth," "Book One," "Palangraphic," "IQE Schoolbook," and "IQE Chancellery." A Univers Condensed works well with the Univers face built into the printer, and the two sets of

faces are superior to PostScript's Helvetica and Helvetica Narrow. IQ's design quality ranges from excellent (IQE's Garamond) to middling (the "Palangraphic").

IQ supplies HP-standard "autofont" files that let you install the cartridge automatically in *WordPerfect*, *WordStar*, and a few other applications. Direct software support for *Windows* and *1-2-3* is also provided. Plus you get all the files needed to use the IQ cartridge with Ventura Publisher User Group's (VPUG) \$49 LaserJet III driver for the GEM version of *Ventura*. Unless you need PostScript for graphics, IQ's cartridge is probably the only one you'll ever need for the LaserJet III. ■

List Price: SuperCartridge 3PE, \$599. **Requires:** LaserJet III family printer; no extra RAM needed. IQ Engineering, 685 N. Pastoria Ave., Sunnyvale, CA 94086; 800-765-FONT, 408-733-1161.

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First Looks

Storyboard Live! Molds Presentation & Multimedia

HANDS ON
by Luisa Simone

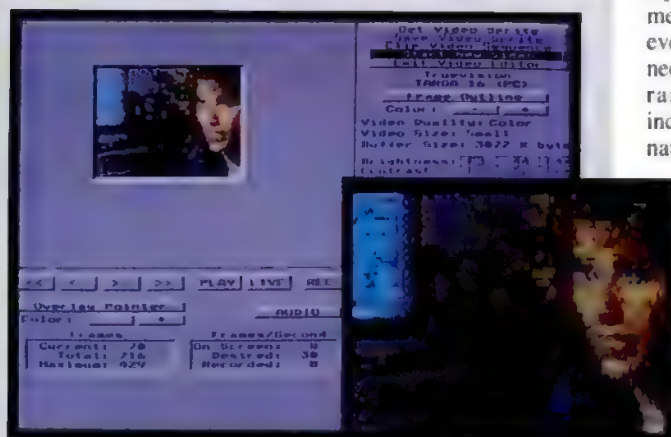
Storyboard Live! proves that presentation graphics and multimedia products are on a convergent path. This \$495 program, which had previous incarnations as *Storyboard* and *Storyboard Plus*, now provides tools to create both old-fashioned screen shows and newfangled video presentations.

Five modules comprise the program: Story Editor, Story

soft PowerPoint. For instance, it does not automatically apply a master to your slides, nor does it store the components of a presentation in one file.

More important, Electronic Presentation cannot display any of *Storyboard*'s special effects. Effects can be entered only via the Story Editor. (Story Teller can be used to play back and distribute a runtime version of your presentation.)

Long-time users will recognize many of the sophisticated



Storyboard Live!'s built-in controls make digitizing video a snap, but the program's palette reduction algorithms produce heavy posterization effects.

Teller, Picture Maker, Picture Taker, and Electronic Presentation. The last module, the new addition, is ideal for creating simple presentations. You can visually reorganize thumbnails of your images, add or delete frames via icons, and keep multiple images stored in an on-screen scratch pad.

From the Electronic Presentation module you can run a preview of your show and also import images, either as background templates or as foreground pictures. Though *Storyboard Live!* distinguishes between templates and pictures, it lacks many of the conveniences offered by programs like *Micro-*

commands in Story Editor. As in previous versions of the program, you can still display images, branch to subroutines, accept user input variables, and carry out if-then statements. New items, such as /Audio, /Sprite-Video, /Midi, and /Overlay, make it possible to access moving pictures and sound.

Full-frame, full-motion video requires either the IBM Motion Adapter/A or VideoLogic's DVA-4000 board. As with any other multimedia product, you must have the specialized board and a video source, such as a laserdisk or VCR, installed for both creation and



FACT FILE

Storyboard Live!

IBM Desktop Software, 472 Wheelers Farm Rd., Milford, CT 06460 (for product information write: P.O. Box 2150, Atlanta, GA 30301); 800-IBM-7699. List Price: \$495; upgrade, \$120.

Requires: 640K RAM, hard disk, EGA, VGA, or 8514/A graphics adapter, DOS 3.3 or later; mouse recommended.

In Short: *Storyboard Live!* delivers both screen-based and multimedia presentations on a budget. The archaic interface and the quality of the disk-based video need improvement.

CIRCLE 550 ON READER SERVICE CARD

playback. Inserting the /Overlay command from the selection menu is a snap. Novices, however, may be flustered by the necessity of typing in the parameters and variables—including things like x,y coordinates—to create a transparent window, fade to the video, or turn the disk player on and off.

The Story Editor's /Sprite-Video command offers a less hardware-intensive, pseudo-video alternative to full motion. Using a video capture card you can record images to disk and save

them as though they were sprites (*Storyboard*'s canned animation effects). Our testing with a Truevision Targa Plus system revealed some flaws with this approach, however. *Storyboard* saves the video images to disk using the computer's current graphics resolution. The Targa board's luscious 24-bit color is reduced to video images that contain either 16 or 256 colors.

If your desired recording parameters (color, the size of the video sprite, the video buffer size, and the frames per second) exceed your system resources, *Storyboard Live!* automatically records the animation at a slower speed. Even with the smallest video window and a buffer of 5MB, we could not get a color image to record faster than 12 frames per second—less than

half the speed of full motion video's 30 frames per second.

Most users will benefit more from *Storyboard*'s newfound ability to customize sprites using the sprite editor within Story Editor. Simply choosing from seven object types and eight preset motion effects lets you turn text strings, imported pictures, and numeric data into sprites.

There are limitations. The size of the sprite is limited to less than a third of the screen, and a chart can only have six data items. Creating a sprite from scratch is also problematic. You literally have to paint each changing frame of the animation, and the sprite editor's paint tools are not up to the task.

Some tweaks to the Picture Maker module make life easier. You can now import standard file formats like .PCX, .TIF, and .CGM. However, *Storyboard*'s limited ability to reconcile conflicting palettes means that even screens captured with Picture Taker aren't always displayed correctly.

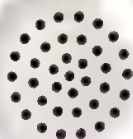
The only way to learn *Storyboard*'s arbitrary command structure is by brute memorization. Even long-time users might wonder why you access audio recording functions from the File menu, but you must access video recording functions from the Modes menu.

Storyboard Live! promises to bring multimedia to the masses. With a low list price of \$495, and an upgrade price of only \$120, cost is no obstacle. IBM is courting the masses in other ways, too. *Storyboard* now supports a wider (read non-IBM) array of hardware devices, such as Jovian Logic's VIA board, Truevision's Targa cards, and the Creative Labs Sound Blaster.

If you are willing to purchase the necessary hardware, *Storyboard Live!* lets you crunch out bona fide multimedia presentations. If you are willing to accept *Storyboard*'s resolution and fidelity compromises, you can create disk-based video and audio files that don't require specialized hardware for playback. The choice depends on your inclination and budget. ■



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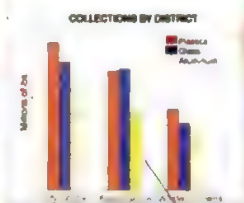
Material collections increased over the year. Plastics continue to bring in the most revenue and profit for the company. Prices for aluminum are also very soft and while we're continuing to collect more glass materials for the raw material are still in their infancy.

Quarter	Q1	Q2	Q3	Q4	1980
Plastics	1,880,710	1,582,054	2,378,357	2,826,993	9,068,114
Glass	1,700,504	1,892,130	1,889,430	2,800,864	8,322,928
Aluminum	1,148,854	1,182,022	1,455,421	1,801,793	5,422,090
Total	4,729,173	4,656,196	5,723,208	7,429,650	22,813,132

The graph at the right details our revenue by waste material for the four quarters of 1980. The revenue increases show that companies are building their recycling programs beyond just collecting plastics. Revenue from glass and glass have increased as their programs have gained volume. But, we're still seeing price pressure as the supply of recyclable materials continues to exceed the demand. We need to look for ways to expand our markets and increase the use of recycled materials.

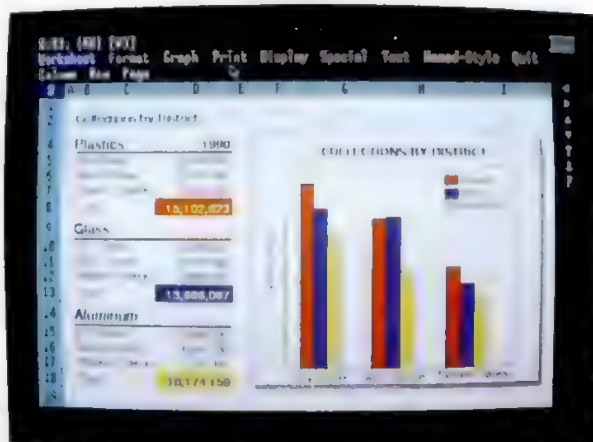
Collections by District

Plastics	1980
NY Center	8,633,899
South Shore	5,75,490
Western	3,523,444
Total	14,912,833
Glass	8,322,928
Aluminum	5,422,090
Total	28,657,851



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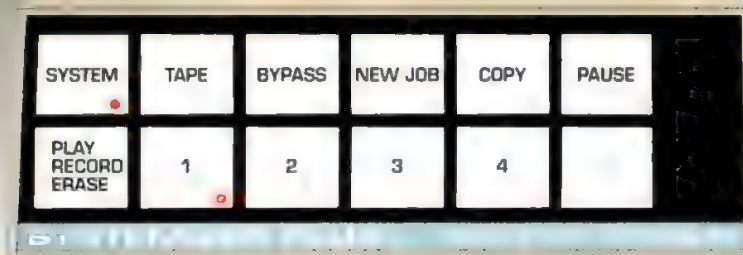
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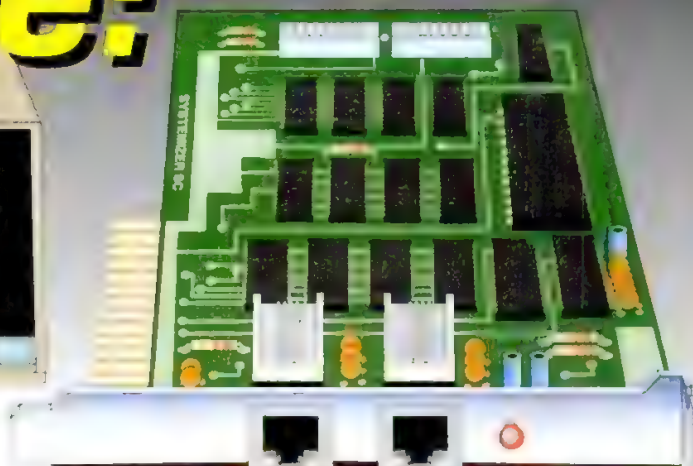


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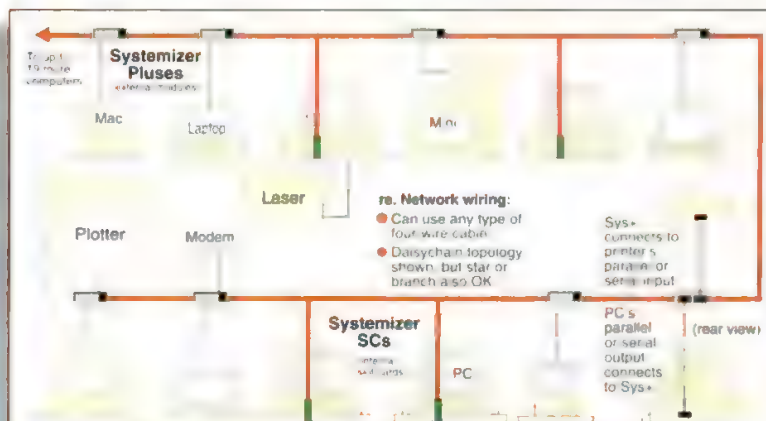
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First Looks

OS/2 Reconsidered: Faster and Smaller Version 1.3

HANDS ON
by Joe Salem

With its checkered history, a dearth of applications, and the recent confusion over who's in charge, OS/2 is a shaky proposition. Many potential users have decided to ignore it. As Windows 3.0 takes the PC world by storm, many are proclaiming OS/2 to be either dead or orphaned.

To paraphrase Mark Twain, reports of its death are greatly exaggerated. Although the changes from 1.2 have been evolutionary, there are some new features in IBM's OS/2 1.3 Standard Edition that make it worth taking another look.

The most significant changes are in 1.3's speed and memory requirements. IBM's programmers carefully combed the OS/2 code, reducing the minimum RAM required from 2.5MB to 2MB (with the DOS compatibility box activated). I measured an additional 350K of available RAM over Version 1.2; the DOS box registered in at about 530K RAM.

The increase in speed is also quite noticeable. The video redraw is much faster, and applications load faster than they did under 1.2. Swapping to disk is noticeably faster, especially if the system is set to swap to an HPFS (High Performance File System) partition. However, even with faster swapping, the system will be slow if there isn't enough RAM. While 2MB is the minimum, 4MB is needed to do productive work.

The installation program has been improved. Instead of loading the entire system, the 1.3 installation program offers you a choice of Country Information (foreign-language support), and prompts you as to whether to load the on-line documentation, which includes the Command Reference and the tutorial.

Other installation options include fonts, the HPFS, system utilities such as Back-

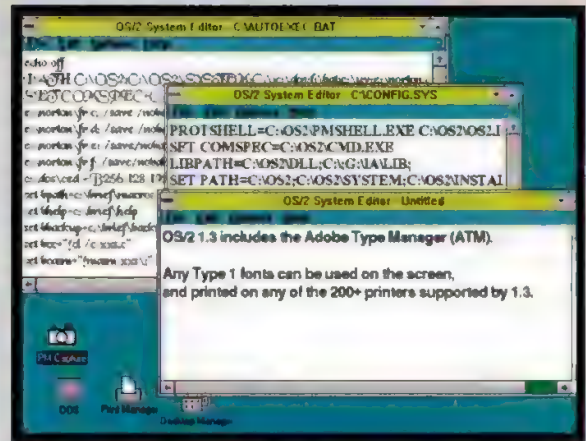
up/Restore, picture utilities, serial device support, and the diagnostics. By only installing your necessities, you can save on hard disk space. The installation program is also smart enough to know when 1.3 is already present on your system; it will put you right into the options menu to install items that you bypassed initially.

The 1.3 manual has slimmed down; the *OS/2 Command Reference* is now a separate item that can be ordered from IBM. However, the on-line command reference guide is hypertext-like and well done.

The second big addition to 1.3 is the inclusion of the *Adobe Type Manager (ATM)* as part of the system. In addition to the default OS/2 fonts, any Type 1 font can be installed for both the screen and supported printers. (Supported printers now number over 200.) Helvetica, Times Roman, Courier, and Mono Space fonts, with variations such as bold and italic, are included. I tested ATM's prowess with some additional Type 1 fonts; they were easily installed, and displayed properly on the screen. Version 1.3 also includes PostScript fonts as the default for downloadable fonts, but other Type 1 downloadable fonts are supported as well.

Another nice touch is the selectable font sizes for text windows; instead of 1.2's limiting choice of a small or large font, 1.3 lets you choose text fonts ranging in size from 8 by 8 to 18 by 8. Changing the text font changes the size of the window.

Beginning with 1.3, IBM is including REXX as part of all versions. Previously it was included only in the 1.2 Extended Edition. REXX is IBM's main-frame procedural language; under OS/2, it provides enhancements to the existing batch file capabilities. Since REXX procedures end with the same extension as OS/2 batch files, they can be enhanced using REXX's 95 instructions and functions.



The addition of the *Adobe Type Manager* expands OS/2 1.3's font capabilities.

Though REXX is primarily character-based, the PMREXX program adds a Presentation Manager interface to REXX procedures. TRACE functions make it easy to debug them.

One major problem plaguing OS/2 over the years is that each new version "breaks" programs written for the previous version. Unfortunately, OS/2 1.3 maintains the tradition. While none of the Presentation Manager programs I tested failed to run, I did find that some program features didn't work properly, or caused protection violations. However, all the character-mode applications I tested ran without a hitch. The bottom line: If you upgrade to 1.3 you should test existing PM applications carefully.

Microsoft has released beta

versions of the utilities supplied with Windows 3.0 as Software Migration Kit (SMK) OS/2 applications. While the utilities have exhibited some quirks, they ran as well under Version 1.3 as they did under 1.2.

Microsoft also announced that it would be releasing its own version of 1.3 to its OEMs within 90 days of IBM's release. Meanwhile, I've installed and run 1.3 on my Northgate without any problems. It appears that if your compatible runs IBM's OS/2 1.2 without any problems, it should also be able to run 1.3.

OS/2 1.3 resolves most of the complaints about prior versions. Printer support is improved, and the addition of ATM makes it easier to print from the Presentation Manager.

OS/2 1.3 is as good as OS/2 can get for 80286-based systems. Existing OS/2 users should consider it. But OS/2 still isn't the place to get your work done. The lack of OS/2 versions of common application packages is an obstacle to using OS/2 1.3. Many potential users will want to wait for OS/2 2.0, with its ability to multitask DOS applications.

The additional features of 1.3 are a good indication of the capabilities that 2.0 will have. But unless a flood of OS/2 applications appear over the next few months, users without an immediate need for OS/2's features should probably wait for the release of 2.0.

**FACT FILE**

OS/2 1.3 Standard Edition
IBM Corp., Armonk, NY 10504;
800-426-2468.
List Price: \$345; upgrade free to owners of 1.1 and 1.2 until March 29, 1991.
Requires: 80286 or better processor, 2MB RAM, 8MB of hard disk space. Mouse recommended.
In Short: Evolutionary improvements make OS/2 1.3 the best version possible for 80286 machines, but users with no pressing needs will want to wait for Version 2.0.

CIRCLE 447 ON READER SERVICE CARD

First Looks

Release 11: AutoCAD Remains Leader of the Pack

HANDS ON
by Jeff Prossie

You've got to hand it to them; the folks at Autodesk are determined, both to keep the advances coming, and to correct the chinks in *AutoCAD*'s armor. A host of enhancements to *AutoCAD*, Release 11—ranging from the addition of network support to 3-D solid modeling capabilities—go a long way toward solidifying *AutoCAD*'s position as the market leader.

AutoCAD's new networking features eliminates the non-networked peril of data loss when two users call up the same drawing simultaneously. Release 11 provides file-locking services. When a drawing or any other *AutoCAD* file is in use, the user is notified that the file is temporarily unavailable, and is provided with the name of the person who "owns" it. File-locking can be overridden at your own risk.

Installing *AutoCAD* on a network server also means you only have to support one copy. And every networked user has access to the same *AutoCAD* facilities. However, a 20-user version of *AutoCAD* costs the

same as 20 individual copies.

One of the most significant new enhancements to Release 11 is the integration of the Advanced Modeling Extension. AME, which is available for an additional \$495, adds sophisticated 3-D solid modeling capabilities to the basic *AutoCAD* package. Using solid primitives such as boxes, cylinders, cones, and spheres, you can construct complex composite solids by using Boolean operators to compute the union, intersection, or difference between them. If you don't like the primitives supplied with the product, you can make your own using commands such as SOLIDIFY, which converts any *AutoCAD* object that has a thickness into a solid, or SOLREV. SOLREV's are created by revolving a polyline about an axis. AME creates fillets and chamfers on command. It even rounds off the corners where filleted edges intersect.

AME uses the CSG (Constructive Solid Geometry) method to represent geometric data. This makes it easy to edit existing objects because *AutoCAD* "remembers" what objects and operations were used

to arrive at the present geometry. Once a solid is created, AME will calculate mass properties—mass, volume, centroid, moments of inertia, products of inertia, radii of gyration, and principal moments. You can display the model with hidden lines removed or use *AutoCAD*'s new SHADE command to produce a shaded likeness. You can also export a model to *AutoShade* for photorealistic rendered images. (*AutoShade* 2.0, scheduled to be released the first quarter of 1991, will incorporate Pixar's *RenderMan*). You can also generate profile views to paste into 2-D drawings. And in one of AME's most impressive displays of power, you can cut an arbitrary section through the model and export the resultant planar image to another *AutoCAD* drawing.

Release 11 also lets you reference external drawings in the active drawing. The reference and active drawings are stored as separate files, but when the active drawing is loaded, the reference document is too. This makes it easy to maintain a standard drawing format in a drawing database and to have drawings automatically updated to the new format each time they're called up or plotted.

AutoCAD 11 features Autodesk's second-generation *AutoCAD* Development System (ADS), which provides C programming hooks into the *AutoCAD* kernel, much like *AutoLISP*. ADS can be used to create custom applications that run inside *AutoCAD* or to interface *AutoCAD* to other applications. If you're wondering just how far you can take ADS, just look at AME. AME is itself an ADS application—a testament to the power of the ADS programming facility.

New database audit and recovery features permit you to verify the integrity of the drawings database and recover data from damaged *AutoCAD* files. In the past, if any part of an *AutoCAD* drawing file was corrupted, the entire file was lost. Now files may be diagnosed and errors repaired in a process that's analogous to CHKDSK's repair of a hard disk's file allocation table.



FACT FILE

AutoCAD, Release 11
Autodesk Inc., 2320 Marinship Way, Sausalito, CA 94965; 415-332-2344.

List Price: \$3,500; upgrade from Release 10, \$500; upgrade from Release 10 for 386, \$200. Advanced Modeling Extension (AME) available for an additional \$495.

Requires: 80386 or 80486 CPU (386 must be step B0 or higher); 2MB RAM minimum, 4MB recommended (3MB minimum with AME); 20MB hard disk; high-density floppy drive; 80287 or 80387 math coprocessor required on 386 systems; DOS 3.3 or later. Mouse or digitizer recommended.

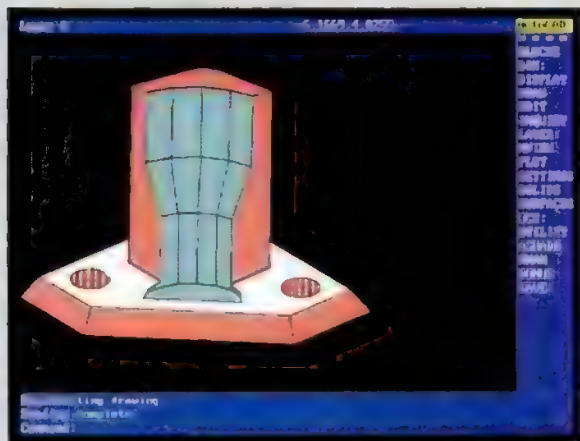
In Short: A greatly enhanced and network-aware version of *AutoCAD* that features sophisticated solid modeling capability, solid file-locking, a mechanism for recovering damaged files, integrated shading capabilities, the ability to reference external drawings, multiple-view drawings, and much, much more.

CIRCLE 700 ON READER SERVICE CARD

With Release 11, you can set up different views of a drawing on one page and annotate the views individually. This brings *AutoCAD* on par with other CAD programs that provide similar capabilities.

Like the 386-specific version of Release 10, Release 11 (which also requires a 80386 or 80486 processor) uses Phar Lap's *386/DOS-Extender*. You'll want memory, and lots of it. *AutoCAD* will use every last byte of memory in your system for large drawing files. When physical RAM falls short, a virtual memory management system will swap data in and out to disk as needed.

Release 11 boasts other enhancements too numerous to detail: command aliasing, dialog boxes for editing text, an array of dimensioning enhancements, new text alignment options, extended undo support, more efficient plot optimization, improved IGES transfers, and an extended data facility for attaching data to entities in an *AutoCAD* drawing. In all, there's plenty enough to justify the cost of an upgrade. ■



AutoCAD's new Advanced Modeling Extension (AME) supports the creation of sophisticated composite solid models using solid primitives and Boolean operators.

DOS Lives. Despite what you may have read.



Insufficient memory to run application;

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Windows 3.0 may have been a big step forward for some programs.

But it was a big step backward for DOS. Suddenly, it was 1987 all over again. Not enough room for DOS programs to run because TSRs, utilities, drivers and buffers were taking up room your DOS programs need.

QEMM 5.1 to the rescue

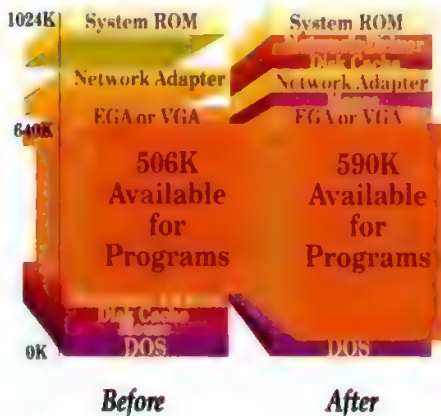
Now, we've updated QEMM to provide additional memory for DOS programs within Windows 3.0.

QEMM 5.1 works with the built-in capabilities of your 80386 or i486 processor to find and recover unused memory segments. As you can see in the chart, there are gaps in your PC's memory usage above 640K. QEMM 5.1 fills those gaps and provides more room for your DOS programs to run.

And of course, QEMM 5.1 still works with DOS when you're not running

When Windows 3.0 says there's not enough room to run your DOS programs, it's just trying to tell you it needs QEMM 5.1.

Windows. You get all the same benefits: up to 130K more memory to run the new generation of memory-hungry programs; space for larger spreadsheets and database files.



Unused memory is like hidden gold in your PC. QEMM finds it and makes it available.

Introducing DESQview 2.3 and DESQview 386 2.3 for users of Windows 3.0

They said it couldn't be done, but DESQview 2.3 can run Windows 3.0 programs. Not just in Windows "Real mode" but in "Standard" mode. That means programs can be up to 16MB.

And it can run DOS programs and DOS-extended programs i.e., 1-2-3 Release 3, side-by-side.

DESQview 386 2.3 does all that and more. It lets you run 386 DOS extended programs like AutoCAD 386 and IBM Interleaf side-by-side.

DOS, extended DOS; Windows—whatever standards you set, we will support. We're committed to helping you get the most out of your hardware and software today. And tomorrow.

QEMM-386 System Requirements: 80386-based PCs and PS/2s and PCs with 80386 add-in boards. Operating system: PC DOS 2.0-4.0, MS DOS 2.0-4.0, Windows 3.0. Conventional memory requirement: 1.5K.

DESQview System Requirements: IBM Personal Computer and 100% compatibles (with 8086, 8088, 80286, 80386 or i486 processors) with monochrome or color display; IBM Personal System/2 • Memory: 640K recommended, for DESQview itself 0-155K • Expanded Memory (Optional): expanded memory boards compatible with the AST RAMpage; EMS 4.0 expanded memory boards • Disk: two diskette drives or one diskette drive and a hard disk • Graphics Card (Optional): Hercules, IBM Color/Graphics (CGA), IBM Enhanced Graphics (EGA), IBM PS/2 Advanced Graphics (VGA) • Mouse (Optional): Mouse Systems, Microsoft and compatibles • Modern for Auto-Dialer (Optional): Hayes or compatible • Operating System: PC-DOS 2.0-4.0; MS-DOS 2.0-4.0 • Software: Most PC-DOS and MS-DOS programs, programs specific to Microsoft Windows 1.0-3.0, GEM 1.1-3.0, IBM TopView 1.1 • Media: DESQview is available on either 5-1/4" or 3-1/2" floppy diskette.

Trademarks: Windows, MS-DOS: Microsoft Corporation; PS/2, Interleaf, TopView: IBM Corporation; 80386, i486, AboveBoard: Intel Corporation; 1-2-3: Lotus Development Corporation; AutoCAD 386: Autodesk, Inc.; RAMpage: AST Research; Hercules: Mouse Systems; Hayes: GEM, Digital Research, Inc.

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First Looks

Ask*Me 2000 Targets Low-Cost Multimedia Authoring

HANDS ON
by Robert Kennel

Innovative Communications Systems' *Ask*Me 2000* brings many of the functions of costly multimedia authoring systems within the reach of modest budgets. This \$495 DOS-based package lets you meld .PCX images, text overlays, animations imported from Autodesk *Animator*, digitized sound, and digitized still-frame video images into a slick interactive presentation replete with customized menus. Unfortunately, unlike most high-end development products, *Ask*Me* doesn't support full-motion video, and unlike other multimedia products it has no animation, screen capture, or paint tools of its own.

*Ask*Me 2000* is based on a powerful scripting language that is able to link disparate elements into a multimedia whole. In an attempt to make *Ask*Me 2000* accessible to nonprogrammers, the vendor fit it with a graphical interface that facilitates some of the authoring steps, particularly fashioning menus. Icons and dialog boxes help the user choose a menu's format, fonts, and colors. For the most part, though, when negotiating the powerful script language that controls a presentation, you're on your own.

You create your presentation a segment at a time and later link the different segments together with a branching structure. Each segment contains commands that execute presentation events. You have the option to create a menu that will let the viewer select branching points—controlled by key presses or by the value of a defined variable. Alternatively, any portion of a presentation can loop continuously or jump to another segment after a specified duration.

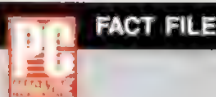
*Ask*Me 2000* displays im-

ported .PCX files in most VGA and extended VGA modes. It can even scale images on the fly, though this slows down the display. A good selection of wipes, dissolves, and fades moves you from one image to the next.

The program sports an excellent feature for bringing in digitized photographs via either a USVideo Daughter Card or a Digital Vision Computers Eyes still-frame video capture board. Just plug in a digital camera and *Ask*Me* lets you preview each shot stored in the camera, adjust the colors, and save pictures as .PCX files.

You can overlay text on an image using a generous assortment of fonts in any color, replete with optional drop shadows or frames. Unfortunately, you must position text by typing in coordinate parameters, which leads to trial and error. This annoying problem is compounded because there is simply no easy way to preview your typeface prior to positioning the text.

Selecting colors for text and backgrounds is also a headache. You must type in the number corresponding to a color's posi-



Ask*Me 2000, Version 2.01
Innovative Communications Systems Inc., 2534 26th Ave. South, Fargo, ND 58103; 701-293-1004.

List Price: \$495

Requires: 640K RAM, 1MB LIM EMS, hard disk (with at least 28-ms access time and 7MB free), color VGA display with 256K RAM, DOS 3.2 or later, Microsoft Mouse.

In Short: *Ask*Me 2000*, a low-cost system for multimedia presentations, has a powerful but complex scripting language. Despite the existence of a professional version, this package is out of the reach of casual presentation developers.

CIRCLE 701 ON READER SERVICE CARD

tion in the palette of the last image loaded. Since the program won't display this palette, you are again faced with time-consuming guesswork.

*Ask*Me 2000* provides a number of predefined branching menu templates to help you build an interface for your presentation, including a standard list query of up to 500 items, a true/false screen, a data acquisition menu, two different styles of multiple choice menus, a numeric keypad, and a page-through text presentation menu. If you want to stray from the program's predefined menu layouts, you can create your own menu screens using a paint program, or you can use the text

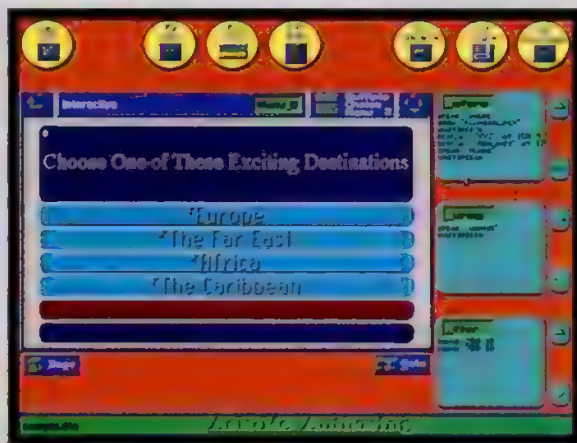
overlay functions and then designate areas of the screen as hot-buttons.

The program will let you prompt the user to enter information that can be stored in variables for later use, and even written to ASCII files, making *Ask*Me 2000* a good candidate for designing computer-based training materials. You can even perform calculations on variables.

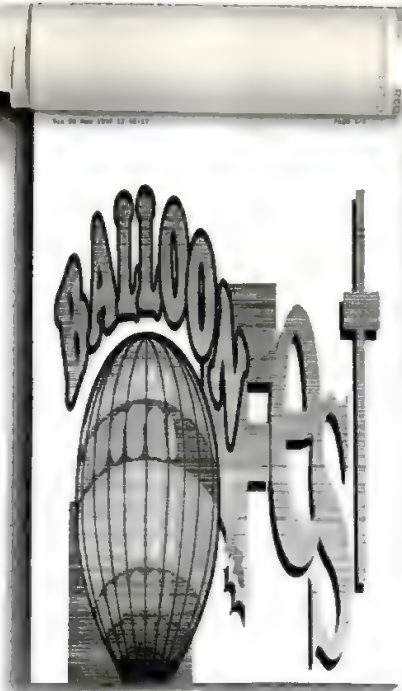
*Ask*Me 2000* handles digitized sound well, supporting Brown-Wagh Publishing's Sound Blaster, Video Associates Labs' Microkey Sound Board, and ANTEX sound boards. The on-screen equivalent of a tape deck lets you record input from a microphone or stereo and save the sampled sound in a file. Thus you can enhance a presentation with music or spoken instructions, and you can choose whether or not on-screen events and user input will interrupt playback.

The flexibility of *Ask*Me 2000*'s script language—especially its finesse in handling viewer input and variables—can make it the source of impressive, highly interactive demos and presentations. Unfortunately, the stark interface, lack of on-line help, and often inadequate documentation are likely to intimidate all but professional developers. Yet few developers will be willing to tolerate the package's primitive script editor, which forces you to create or edit lines one at a time in a dialog box without the aid of cut-and-paste capabilities. The package has other rough edges, such as bugs that prevent fade-ins and colored frame drawing from working properly.

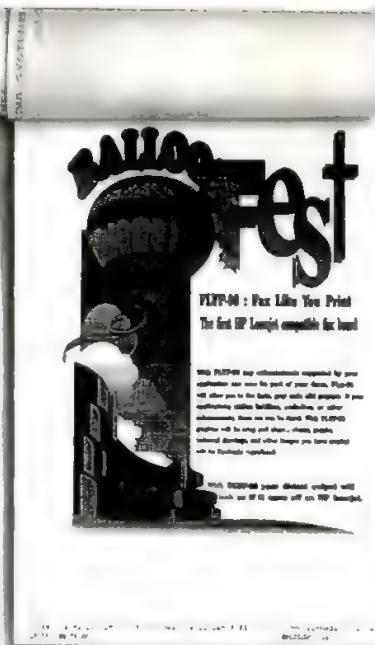
ICS promises a modernized script editor in the next release, along with the capability to position text using the mouse. A forthcoming Windows version of the program should address other *Ask*Me 2000* interface problems. The vendor also markets a \$1,795 high-end version of the program called *Ask*Me Professional*, available to VARs. This version uses the identical scripting language but adds support for full-motion video and advanced multimedia database functions.



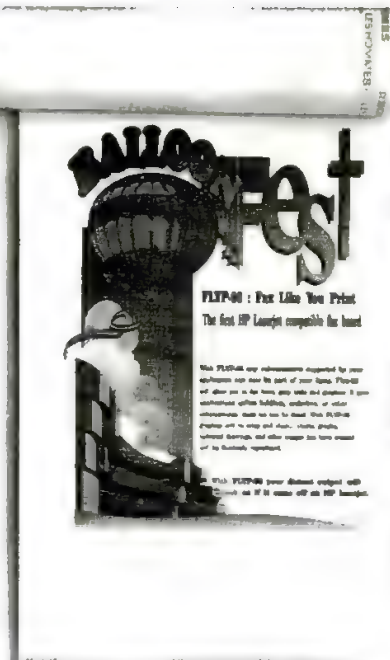
The customized menus you create in *Ask*Me 2000* let the viewer control the branching of your presentation.



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First Looks

Connecting/ROOM Loads Terminal Emulation Software into High Memory

HANDS ON
by Sara Parker

Connecting/ROOM from Helix Software loads 3270 terminal emulation software into extended, expanded, or disk memory, freeing conventional memory for your applications. The package supports terminal emulation programs that utilize Token Ring, NetBIOS, and Novell's IPX/SPX protocols, as well as standalone coax, and serial connections.

Connecting/ROOM is the third in a suite of highly acclaimed products from Helix. The first, *Headroom*, has all the features of *DESQview*. The next, *Netroom*, loads Novell's IPX or NET3 executable files into extended or expanded memory. Now there's *Connecting/ROOM*. All three packages include *Discover*, a handy utility that provides a potpourri of information detailing the type of memory available and the memory configuration for a given machine. *Connecting/ROOM* also includes a Minidisc utility that scrolls the information from memory onto the video screen.

The installation program copies all of the *Connecting/ROOM* files into a directory called CROOM. Two small programs, CR and CRIPX, control the memory environment by first loading themselves into

conventional memory, then capturing the 3270 terminal emulator program. The next program loaded in the sequence is CRSWAP. It swaps the emulation program with an optional parameter setting that can specify extended, expanded, or disk swapping; the default setting is expanded memory.

I tried *Connecting/ROOM* with a variety of 3270 terminal emulation programs including Attachmate's *Extra!*, Novell's *PCOX/GW-3270*, and DCA's *IRMALAN*. The program saves about 50K of conventional memory when loading Attachmate's *Extra!* 3270 Cut mode terminal emulation. With both Novell and DCA products, the savings are well above 100K, although if you use DCA's built-in memory management features, the memory savings aren't as high.

The CRSWAP program relies on a hotkey. Each time you activate it, a bar graph depicts the emulation as it is swapped into conventional memory.

While the product documentation only guarantees compatibility with Novell's 3270 workstation software, *PCOX*, and DCA's *IRMALAN*, Attachmate's *Extra!* worked fine. The software swaps standalone Cut Coax emulation from memory, but cannot remove standalone Coax DFT terminal emulation.

The cut-and-paste utility hotkeys a menu that can copy any section of a text screen to memory. The contents of the memory are then pasted into your application. You can also cut and paste ASCII files into memory. The memory buffer, normally 2K, can be increased

to 56K. An append function allows you to add information to previously cut data.

With today's memory-intensive applications, *Connecting/ROOM* offers a cost-efficient solution for using terminal emulation software. ■

List Price: *Connecting/ROOM*, 10-user license \$995; 50-user license, \$1,995. **Requires:** Terminal emulation software, DOS 3.1x or later. Helix Software Co., 83-65 Daniels St., Briarwood, NY 11435; 800-451-0551.

CIRCLE 480 ON READER SERVICE CARD

RoundTrip's 2-Way Data Integration

HANDS ON
by Craig Stinson

RoundTrip is a fourth-generation language designed to move data from disparate sources into spreadsheet (.WK1) files, and from spreadsheet files to non-spreadsheet formats. It's also an all-purpose tool for moving information between worksheets.

As the name suggests, *RoundTrip*'s capabilities are bidirectional. It can grab data from a mainframe and send it back. You can use it to generate reports or to suck information out of report files. You can consolidate spreadsheets with it and spread consolidated files into subsidiary worksheets.

Input sources can be used to update existing spreadsheets or to create entirely new ones. Data can be aggregated and sorted on up to 15 fields. You can choose to process all input data or only records meeting specified criteria. In creating output worksheets, the system can automatically accommodate variable numbers of input rows, as well as generate totals, subtotals, and record counts.

Output worksheets are specified via "pattern files," which are normal .WK1 files containing special *RoundTrip* program code. The codes tell *RoundTrip* where to put incoming data and what to do with it. Because they're ordinary spreadsheet files, these pattern files can also include both *Lotus 1-2-3* and *Allways* formatting information, macro code, printing

specifications, range names, and so on—faithfully conveyed to your output worksheets.

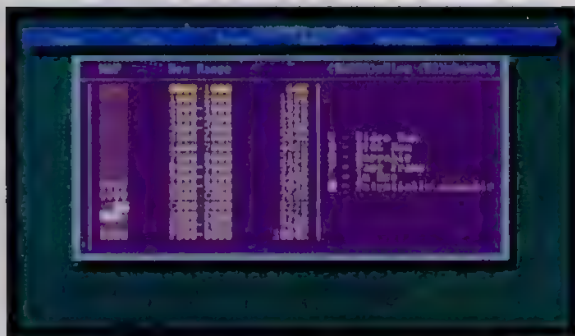
RoundTrip's only serious problem is complexity. Fortunately, the system can be used without assimilating all its details. The current version, 2.0, adds an elaborate system of menus and dialog boxes to insulate the novice from its programming language. The new front end transparently steps you through the process of creating pattern files and describing data sources, allowing you to perform ad hoc translations and consolidations. Creating fully automated procedures, on the other hand, will send you to the system's language manual.

RoundTrip is still tougher than it should be. The interface is idiosyncratic (for example, it uses Home and End instead of the Tab key to move between dialog-box fields). The help screens don't go far enough. Terms are not well defined on-screen, and error conditions are neither explained nor handled gracefully.

Frustrations notwithstanding, *RoundTrip* is the most versatile tool of its kind. For the spreadsheet user who needs to manipulate massive amounts of data from disparate sources, it may well be indispensable. ■

List Price: *RoundTrip 2.0*, \$495. **Requires:** 512K RAM, 720K of available disk space, DOS 2.0 or later. CFO Reporting Systems, 17920 NE 154th St., Woodinville, WA 98072; 206-483-6531.

CIRCLE 601 ON READER SERVICE CARD



Connecting/ROOM's *Discover* utility provides an overview of system memory.

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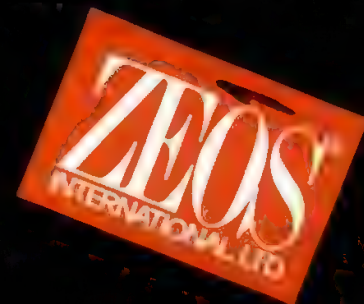
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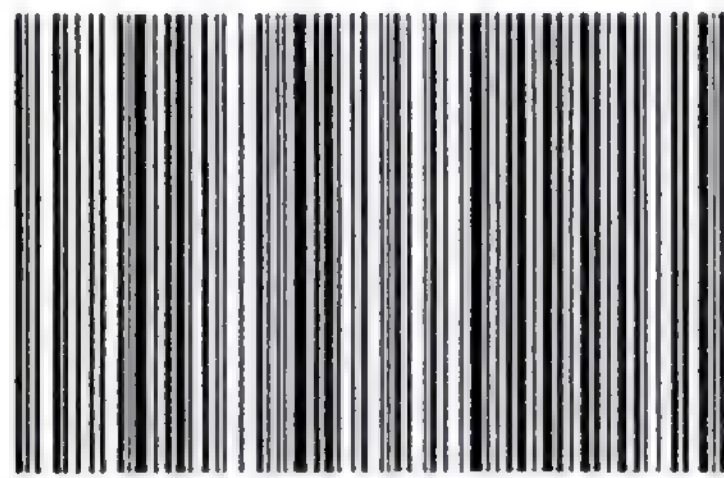
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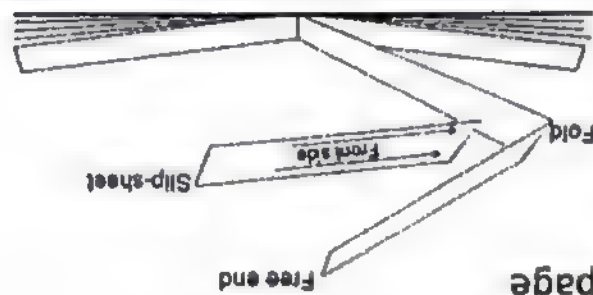
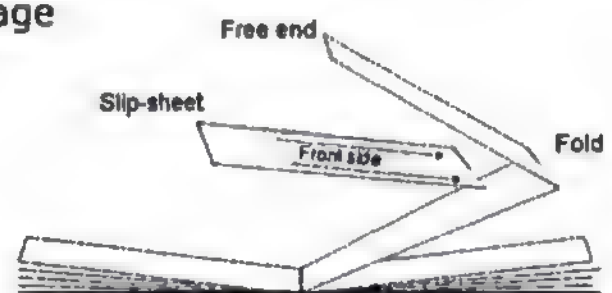


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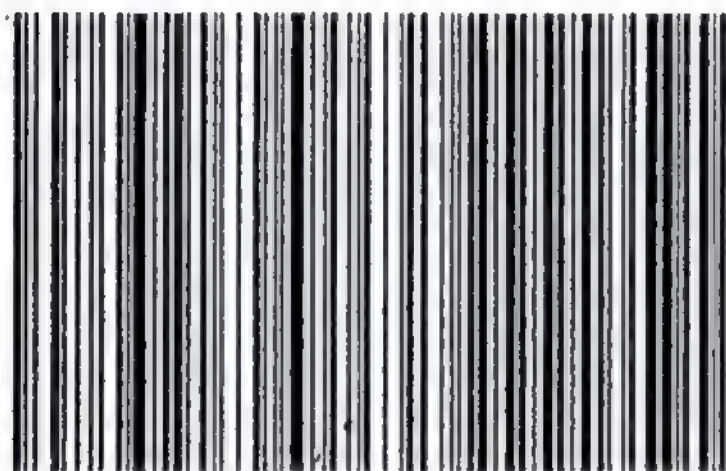
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10 Good Reasons To Buy From ZEOS®

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These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

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In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world!"

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Reason #3

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PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

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InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent."



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First Looks

Up Periscope: New Interface Enhances Debugger

HANDSON
by Ben Myers

More powerful and more expensive than *CodeView* and *Turbo Debugger*, *Periscope* debuggers have long had a respectful following in the software development community. *Periscope* 5.0, the updated software for *Periscope* products, makes working with the netherworld of hardware interrupt routines, communications software, device drivers, and TSRs easier. Version 5.0 adds an optional menuing front end, allowing new or casual debuggers access to this powerful tool.

Periscope is available in five models, ranging from software-only to software-hardware combinations. Since we last reviewed the product (First Looks, August 1987), all of the hardware has also been revamped. Model II-X offers the *Periscope* debugging software; Model II adds a breakout switch—a simple red push button on a cable that hooks into the PC bus. The breakout button interrupts any program, including those that are hung, and displays the *Periscope* interface. *Periscope* Model I includes the breakout switch and an add-on board with 512K of memory. The *Periscope* software is loaded onto the memory board where it's protected from software rampant with wild data pointers. There's also a Micro Channel version that can accommodate up to 2MB.

Periscope Model IV offers the ability to let your PC run at full speed while still tracing each instruction and monitoring hardware breakpoints. This model consists of a full-size PC board, a cable, and a "pod." The pod is inserted between your computer's CPU and its socket, allowing *Periscope* to monitor each instruction as it is executed. *Periscope* IV offers both real-time debugging and hardware protection, albeit at

the expense of two PC slots. It also has the advantage of debugging software whose behavior depends upon close event timing, such as LAN drivers and communications boards.

All versions of the *Periscope* software are identical in form but different in function. Release 5.0 adds a menu that behaves like *CodeView* without a mouse. Separate windows display disassembled instructions, memory contents, registers, and the stack. *Periscope*'s drop-down menus allow access to files and symbol tables, manage memory and register access, and control options. You can re-

move the menus and windows once you've memorized the command and function set.

Function keys let you set breakpoints, execute a selected instruction, and trace through or step over instructions. This new version also adds function key emulation for *CodeView* and *Turbo Debugger*. Unlike these, *Periscope* executes software interrupts without affecting the operating system, permitting DOS, BIOS, and device driver spelunking.

Periscope 5.0 requires 135K with menus and 77K without. Both dual-monitor and remote-PC support are available. The software can optionally activate itself during a warm system boot to ferret out malfunctions during device driver loading.

The program can use symbol tables from Microsoft and Borland development products, as well as Sage Software's *PLINK*.

Since it's a DOS-only debugger, you cannot use it under OS/2, and it debugs *Windows* applications only in real mode.

Other debugging products are easier to use than *Periscope*, but in its various incarnations, *Periscope* does things that few others can match. If you spend much of your time on the inside of an operating system looking out, you deserve a *Periscope* to improve your view of the world. ■

List Price: *Periscope* 5.0: Model II-X, \$195; Model II, \$225; Model I (PC bus), \$595; Model I (Micro Channel bus), \$695; Model IV, \$1,895 to \$2,795. **Requires:** DOS 3.0 or later, 77K to 135K of RAM, compatible languages and linkers. The Persicope Company Inc., 1197 Peachtree St., Plaza Level, Atlanta, GA 30361; 404-875-8080.

CIRCLE 448 ON READER SERVICE CARD

dB RACE: A Drop-In, High-Speed Database Engine

HANDSON
by Richard Hale Shaw

No database manager is ever fast enough. Whether you're sorting, searching, or performing file maintenance, a DBMS can gobble up time—particularly on large files (over 50,000 records). LodeStone's *dB RACE* is a \$395 drop-in, high-speed database engine designed to augment the performance of *dBASE*-compatible DBMSs.

The latest release works with *FoxBase*, *FoxPro*, *Clipper*, *dBXL*, and *dBASE III Plus*. It will also work with *dBASE IV*, provided the *dBASE IV* cache is disabled.

The package contains several components: *dBMON*, a monitor that oversees all requests; *dB RACE*, the interactive front end; *dB SWAP*, for maximizing memory usage; and a couple of *dBASE.PRG* programs that invoke *dB RACE* or let you create a batch series of commands.

Upon installation, *dBMON* becomes a .COM file, loads the DBMS, and monitors all file-handling requests, such as which databases and indexes are

opened and used. It can then communicate this and the state of these files to *dB RACE*.

dB RACE can be run interactively or in batch mode, but it's best used from inside your DBMS via the RUN command. The program uses optimized query- and index-handling techniques to find the fastest access path to requested data. Instead of using the *dBASE* indexes, it uses a special set of compressed map files. Provided you create a map for every field that's used in a query, *dB RACE* can perform ad hoc queries in a fraction of the time that most DBMSs require.

Don't give up your DBMS yet. *dB Race* supports only a subset of *dBASE* commands. DELETE and REPLACE, for instance, are not supported. The program is best used to select and record a subset of the database, thus freeing the DBMS's report generator to work only with the needed data and put the data in a new table for later use. Working this way makes a separate database index unnecessary.

How does *dB RACE* measure up? Using conditional queries, it took about 15 to 20 per-

cent of the time required by *dBASE IV* to execute commands on 5,000 records. Most of that time (2 to 3 seconds) was required to load *dB RACE* from inside of *dBASE IV*. With 50,000 records, *dB RACE* took only 2 to 6 percent of the time that *dBASE IV* required. On unconditional tests the numbers were good, but not as impressive. And *dB RACE*'s PACK command performs identically to *dBASE*'s.

dB RACE details such as the packaging, documentation, and interface are unimpressive. Also, the program occasionally gets confused about whether map files need updating. If you have applications that use a lot of database subsets and conditional or ad hoc queries, you'll be delighted with *dB RACE*. If you're looking for a faster way of performing global database operations, you should probably look elsewhere. ■

List Price: *dB RACE*, Version 1.04, \$395. **Requires:** 640K RAM, 200K hard disk space, DOS 3.0 or above. LodeStone Inc., 912 Applewood Dr., Friendswood, TX 77546; 713-996-7460.

CIRCLE 446 ON READER SERVICE CARD

First Looks

Planisoft: Impressive Scheduler Lacks Adequate Docs

HANDS ON
by Jonathan Matzkin

Scheduling is best handled visually, with a grid metaphor, which makes it an ideal task for *Windows 3.0*. *Windows*'s point-and-click interface and powerful graphics let you schedule people and resources much as you would on paper. *Planisoft*, an ambitious time and resource manager from ASD Software, exploits many of *Windows*'s built-in amenities, but falls short of the ease of use that would make it an ideal solution.

Planisoft's main screen is a spreadsheet-like grid that displays days along the top and time (in user-definable intervals) along the left side. To enter an appointment you click on the desired time within the main grid and then enter the necessary information into a dialog box. After a block of time has been booked, the corresponding portion of the main grid is displayed in a contrasting color.

The color of a given time block on the grid conveys considerable information. When you enter an appointment, you can associate it with one color chosen from each of four color groups.

Each color group represents

a characteristic of the appointment; one group of colors can represent location, for instance, with blue denoting conference room A, and red symbolizing conference room B. Another color group might represent topics or purposes for appointments.

You can also choose which color group *Planisoft* uses to color time blocks on the main screen. So if you choose a color group that represents locations as your default, you can tell at a glance exactly where all of your appointments are.

Planisoft generates a separate time grid for each person it tracks. The real power of the program, however, is in its group agenda screen, where you can display a summary that consolidates the schedules of members of a user-defined group. When you schedule a group meeting from within the group agenda, *Planisoft* dutifully enters the appointment in the agenda of each individual in the group. The program also traps conflicts. In addition, the entries can have added information such as notes or deadline information.

I tripped over a few bugs in evaluating *Planisoft*, but these are, for the most part, minor.



Planisoft's main grid gives you a spreadsheet-like view of your appointments, with user-configurable color codes.

Far more troublesome is the so-called tutorial shipped with the product. This misleading document is rife with confusing instructions, contradictions, and inaccurate descriptions of commands and procedures. In several cases, diagrams or instructions seem to come from earlier versions of the software.

ASD has begun shipping a technical reference manual with the software to supplement the tutorial. That seems only fair considering the software's \$349 price tag. And the company promises a completely rewritten tutorial in the near future. In the

meantime, be prepared to spend more time than you should learning *Planisoft*.

When the company does come up with a decent tutorial, however, anyone who spends a lot of time managing people, time, and resources should consider *Planisoft*.

List Price: *Planisoft*, single-user version, \$349. Five-node LAN version, \$895. Ten-user LAN version, \$1,295. **Requires:** *Microsoft Windows 3.0*. ASD Software Inc., 4650 Arrow Hwy., E6, Montclair, CA 91763; 714-624-2594.

CIRCLE 706 ON READER SERVICE CARD

Arc+: A Menu for Arc

HANDS ON
by Jonathan Matzkin

Most file archiving programs support an intimidating laundry list of cryptic command line switches. This presents a real obstacle for someone who already has enough trouble with the arcana of DOS.

System Enhancement Associates (SEA), publishers of *Arc*, seek to reach a wider audience by wrapping their well-known utility in a menu-driven interface that dispenses with command line switches and provides lots of reassuring information about what the program is doing as it shrinks files down to size. The \$89.95 package, dubbed *Arc+*, will look familiar to anyone who has used split-screen file-transfer packages like *LapLink* or disk management software like *XTree*.

The guts of the software, *Arc 7.1*, have changed relatively little. If you don't like menus, you are still free to run it from the command line.

To bring up *Arc+*'s main menu, type "arc" at the DOS prompt. The opening screen is divided into two windows; the left is a file listing for the current directory, and the right is a listing of any archives in the current directory. A tap of the Enter key toggles between a file list and a directory tree view of your files or archives.

There's a menu bar at the top of the screen; on the left side you have three ways to easily

access *Arc+*'s basic functions. The "archive" menu, for example, provides two simple options: pack files away, or unpack them. When working through this menu, you can only create archives of entire subdirectories. File tagging is not supported, as it is in *Arc+*'s more advanced menus.

On the right of the menu bar are five menus which support more flexible operation. You can sort files in many ways and easily tag or untag them for selective compression or decompression. You can also look at an arced file with a View option.

There are limitations. Subdirectory structure is preserved for regenerating the subdirectory from an archive, but you can't browse the archive for a file in a specific subdirectory. Instead, you must search a sorted list of all files in the archive.

This is a minor shortcoming, since you can unpack a subdirectory without disturbing other subdirectories in the archive.

With its menus and display windows, *Arc+* takes some of the mystery out of file compression. With some additional tweaks to maximize ease of use, it could become Everyman's archive program.

List Price: *Arc+* \$89.95. **Requires:** 512K RAM, DOS 2.0 or later. Hard disk recommended. System Enhancement Associates Inc., 925 Clifton Ave., Clifton, NJ 07013; 201-473-5153.

CIRCLE 430 ON READER SERVICE CARD

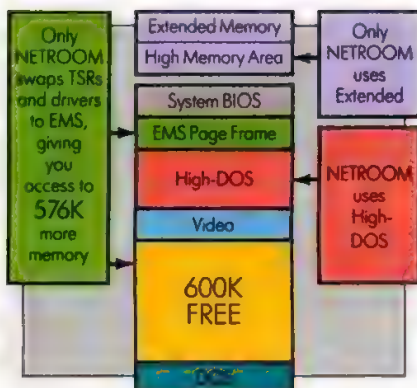
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competition in more ways than one – by giving you access to 576K more memory than QEMM, as well as working on all PCs (8088 through 80486), and in all areas of memory (see chart). In fact, you could say the competition pales in comparison!

And to top it all off, with **NETROOM** you get absolutely **FREE – DISCOVER***, a full-featured analysis utility that tells you all you need to



know about your machine and its memory.

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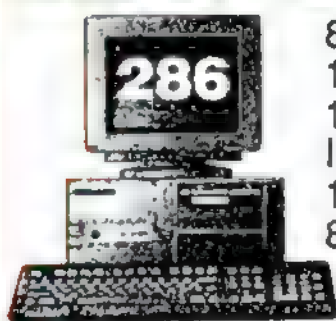
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1.2 MB 5 1/4" Drive
IDE HD controller
101 keyboard
8 expansion slots

\$459

1-year limited
warranty

12" Amber 14" VGA Color
720x350 .41 dp 640x480

40MB 28ms	\$819	\$1049
71MB 28ms	\$939	\$1179
89MB 19ms	\$969	\$1199
124MB 19ms	\$1059	\$1289

Video Card Included! Fully Tested!

COMPUDYNE 386SX-16



80386SX, 16MHz
1MB, 0 wait state
1.2MB 5 1/4" Drive
IDE HD controller
101 keyboard
7 expansion slots

\$629

1-year limited
warranty

12" Amber 14" VGA Color
720x350 .41 dp 640x480

40MB 28ms	\$989	\$1219
71MB 28ms	\$1119	\$1349
89MB 19ms	\$1139	\$1369
124MB 19ms	\$1229	\$1459

Video Card Included! Fully Tested!

COMPUDYNE T386-25C



80386, 25MHz
1 MB, 32K cache
1.2 MB 5 1/4" Drive
IDE HD controller
101 keyboard
8 slots, DOS 4.01

\$1099

1-year limited
warranty

12" VGA White 14" VGA Color
640x480 .41 dp 640x480

40MB 28ms	\$1539	\$1699
89MB 19ms	\$1689	\$1849
124MB 19ms	\$1779	\$1939
211MB 19ms	\$2109	\$2269

Video Card Included! Fully Tested!

Laptops

Arima ACT 286-410



12MHz 80C286
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Keybd detaches
40MB 27 ms HD
1.44 MB floppy
\$1799

Toshiba T1000SE Call
Toshiba T3100SX Call
Megahertz T224
2400bps modem \$129
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TEXAS
INSTRUMENTS



**TravelMate
2000**
only 4.4 lbs!
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VGA Display
20MB 23 ms HD
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14" VGA Color
.31 DP 800 x 600
\$295

Compudyne 14/1024V
14" 1024 x 768, .28DP \$349
Compudyne 14/640V
14" 640x480, .39DP \$259
LTI 12" mono \$69
NEC Multisync 3D VGA \$629
Sony 1304 VGA 1024x768 \$649
LTI 1230A VGA mono \$105

Graphics Cards

STB VGA Basic 640 x 480 \$65
Compudyne VGA 1024
1024 x 768 \$89
ATI BasicVGA 16 \$75
ATI VGAWonder 256 Plus \$179
Sigma VGALegend \$239
Suntek MGP III Mono \$25
Leading Tech CGA Color \$25

Storage Devices

Seagate 157A Drive



40MB storage
28ms access
3 1/2" drive
IDE
\$229

Seagate ST225 20MB
w/controller \$228
Seagate ST238R 30MB
w/controller \$239
Seagate ST1102A 89MB IDE \$479
Seagate ST1144A 124MB IDE \$569
Seagate ST1239A 211MB IDE \$859
Micropolis 1335 71MB ST506 \$499

Floppy Drives

Toshiba 5 1/4" 1.2MB \$62
Sony 3 1/2" 720K \$55
Sony 3 1/2" 1.44MB \$62
Pacific Rim 5 1/4" ext. \$199

Tape Backups

Compudyne 60MB Int \$229
Compudyne 120MB Int. \$319

Printers w/free cables!

Canon Bje10 Bubblejet \$325
Epson LX810 9-pin \$169
Epson LQ510 24-Pin 80 col. .. \$275
Epson LQ1010 24-Pin 132 col. \$389
Epson LQ2550 \$889
Panasonic KX-P1180 \$158
Panasonic KX-P1624
24 pin 1326 col \$399
Panasonic KX-P4420 laser \$789
TI microLaser PS17
PostScript \$1479
Seiko Label Printer \$169

Joysticks

Kraft KCIII Joystick \$14
C&H Flight Stick \$39
Quikshot Gamecard \$12
Quikshot QS123 \$10

Mice

Logitech C9 Serial Mouse \$62
Logitech Trackman Serial \$75
Logitech Trackman Bus \$79
Microsoft Serial Mouse \$84

Keyboards

Chicony 5191 Click 101 \$39
Chicony 5581 101 w/Trackball .. \$69

Boards

Complete Answering Machine \$219
Complete Communicator \$389
Creative Labs SoundBaster \$149

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COMPUDYNE T386-33C



1-year
limited
warranty



80386, 33MHz
2MB, 64K cache
1.2 MB 5 1/4" Drive
IDE HD controller
101 keyboard
8 slots, DOS 4.01

\$1349

12" VGA White 14" VGA Color 14" VGA color
640x480 .41dp 640x480 .31dp 800x600

40MB 28ms	\$1789	\$1949	\$1989
89MB 19ms	\$1939	\$2089	\$2139
124MB 19ms	\$2029	\$2189	\$2229
211MB 19ms	\$2349	\$2509	\$2559

Video Card Included! Fully Tested!

COMPUDYNE T486-25C



1-year
limited
warranty



80486, 25MHz
4MB, 128K cache
1.2 MB 5 1/4" Drive
IDE HD controller
101 keyboard
8 slots, DOS 4.01

\$2199

14" VGA Color 14" VGA color 14" VGA color
.41dp 640x480 .31dp 800x600 .28dp 1024x768

40MB 28ms	\$2689	\$2729	\$2789
89MB 19ms	\$2829	\$2879	\$2939
124MB 19ms	\$2919	\$2969	\$3029
211MB 19ms	\$3249	\$3289	\$3349

Video Card Included! Fully Tested!

Modems

COMPUDYNE 2400i



2400 baud
Internal modem
Viscom software
\$55

ATI 2400 int. w/MNP5 \$145
Compudyne ext. 2400 \$65
Complete Fax 4800 \$139

Software



TurboTax
Simplify figuring
your taxes! For
all major forms.

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Disk Files

5 1/4" disks holds 40 \$2.99
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6 foot parallel \$2.99
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Microsoft Word for Windows \$279
PFS: Pro Write 2.2 w/Pro File \$149
RightWriter 4.0 \$50
WordPerfect 5.1 \$244

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Lotus 1-2-3 2.2 \$319
Microsoft Excel / Windows 2.1d \$298
PFS: First Choice 3.0 w/Prodigy \$93

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Arts & Letters Editor 3.0 \$392
Corel Draw 1.2 \$299
Express Publisher 2.0 (dual media) .. \$82
Harvard Graphics 2.3 \$299
Microsoft Powerpoint / Windows \$279
PageMaker 3.01 \$479
PC Paintbrush IV Plus \$99
Xerox Ventura Pub. 3.0 / Windows .. \$499

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DAC Accounting 4.1 \$76
Pacioli 2000 \$27
Peachtree Complete III \$13
Quicken 4.0 \$35

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Q & A Version 3.0 \$214

Languages

Microsoft C 6.0 \$298
Microsoft QuickBasic \$59
Turbo C++ \$125

Accessories/Utilities

386Max 5.0 \$69
Above Disc 4.0 \$55
Act! 2.0 \$209
Automenu 4.7 \$33
Avery LabelPro \$42
Calendar Creator Plus 3.0 \$35
Compuserve Starter Kit \$19
Copy II PC Deluxe Board \$102
DesqView 2.3 \$67
Direct Access 5.0 (dual media) \$58

FastBack Plus 2.1 \$109
Formwork w/ Fill & File \$78
Headroom V2.02 \$68
Mace Utilities 1990 \$78
Menu Works \$14
Microsoft Windows 3.0 \$85
Norton Commander 3.0 \$89
Norton Utilities 5.0 \$109
Optune \$42
Org Plus Advanced 5.0 \$64
PC Tools 6.0 \$79
QEMM 386 5.1 \$52
Resume Maker \$24
Spinrite II \$59
System Sleuth \$69
Virucide \$28
WinSleuth \$69

Communications

Laplink III \$84
PC Anywhere IV \$89
Prodigy 3.1 \$23

Education/Games

Algebra Plus \$27
BattleChess (dual media) \$27
F-19 Stealth Fighter \$37
Flight Simulator 4.0 \$37
Grand Slam Bridge \$18
Hoyle's Book of Games \$19
Hunt for Red October \$18
Indianapolis 500 \$29
Leisure Suit Larry \$22
LHX Attack Chopper \$35
Math Blaster Plus \$27
Math Rabbit \$20
Micro Cookbook \$24
Monopoly \$21
PC Globe + \$35
Reader Rabbit \$24
Solitaire Royale \$19
Sorcerer \$32
Teenage Mutant Ninja Turtles \$22
Test Drive III \$32
Video Vegas \$18

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only. Defective hardware repaired or replaced at
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There's more to comparing LaserJet PostScript® Language Emulation Cartridges than just the name

	Pacific Data Products PacificPage™ P•E	Hewlett-Packard PostScript® Cartridge
Price	\$499	\$695
Emulation switching	Yes	No
Font cartridge option	Yes	No
Upgrade program	Yes	No
Warranty	Lifetime	One Year

Don't settle for less just to buy the HP name. Ask for Pacific Data Products' PacificPage P•E. It's the PostScript language emulation cartridge for HP LaserJet IIP, IID, III and IIID printers that offers you more for less.

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To learn how you can get more for less, call your nearest dealer or contact: Pacific Data Products, 9125 Rehco Road, San Diego, CA 92121, (619) 597-4601, Fax (619) 552-0889.



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DATA PRODUCTS

by
Cristina Córdova
and Nate Zelnick

New & Improved

News of Announced Products and Upgrades

Intelligence Power System Uses AI To Monitor System Status

NEW

The IPS/A.I., from Elgar Corp. is the first UPS that allows network managers to control network-wide parameters from a single terminal. A 16-bit continuous-sensing microprocessor permits local or remote settings, collection and analysis of power data, and two-way 9,600-bps communications via an RS-232 port. A three-phase light panel displays system status and automatically flags varying conditions of line voltage, load, and battery and system tests.

The UPS is shipped with *IPS/A.I.+* software that consists of an artificial intelligence-based inquiry system. *IPS/A.I.+* enables an orderly system shutdown and includes power diagnostics and management capabilities. The software also monitors system power usage and supplies additional power during peak demand periods. *IPS/A.I.+* tests the UPS daily—either manually or automatically—and reports the status of both bat-

tery charge and UPS conditions. It extends the life of the UPS's battery by draining it after testing.

List Price: IPS/A.I. 600, \$699; IPS/A.I. 800, \$899; *FailSafe A.I.+* for DOS, \$79; *LanSafe A.I.+* for Novell 286, \$99; *LanSafe A.I.+* for Novell 386, \$135. Elgar Corp., 9250 Brown Deer Rd., San Diego, CA 92121; 619-450-0085.

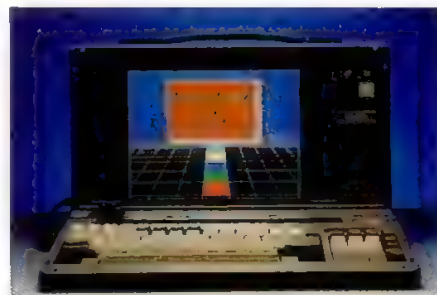
CIRCLE 432 ON READER SERVICE CARD

Dolch Delivers First 486 EISA-Bus Portable

NEW

Dolch Computer Systems has introduced the first 486 EISA-based portable computer, the Dolch P.A.C. 486-33E. The luggable unit weighs less than 18 pounds and measures 9.5 by 16 by 7.8 inches (HWD). It has four full-length EISA/ISA slots that accept standard add-in cards for easy expansion. An optional Back-PAC expansion chassis contains three additional ISA slots, a 200-watt power supply, and a cooling fan.

Dolch offers two optional VGA-compat-



The luggable EISA-based Dolch P.A.C. 486-33E offers a VGA-compatible display.

ible displays for the 486-33E: a red plasma display with 16 levels of gray scale and a TFT (thin film transistor) active matrix color screen. Both are backward-compatible with earlier display standards such as EGA, CGA, and MDA. The Dolch P.A.C. 486-33E also has a VGA port.

The standard configuration includes 2MB RAM (expandable to 32MB), a 100MB hard drive, and a 1.44MB 3.5-inch floppy drive.

List Price: Dolch P.A.C. 486-33E, \$15,995; Back-PAC, \$895. Dolch Computer Systems, 372 Turquoise St., Milpitas, CA 95035; 800-538-7506, 408-957-6575 or 408-263-6505.

CIRCLE 433 ON READER SERVICE CARD

CONTINUES ON PAGE 56

HOT PROSPECT

LOTUS PIONEERS PRESENTATION GRAPHICS SOFTWARE FOR OS/2

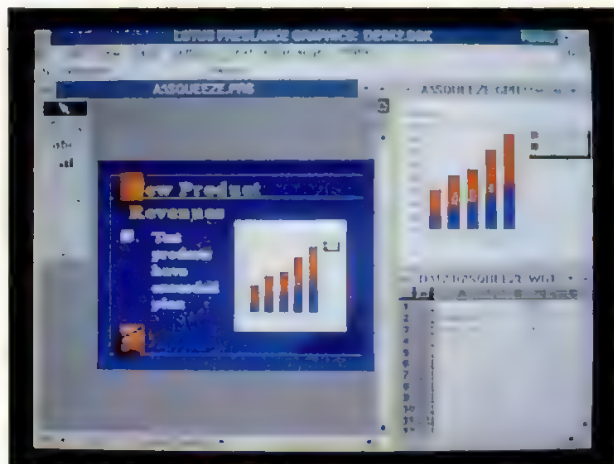
What OS/2 really needs is a few good applications. Toward that end, Lotus Development Corp. has produced *Freelance Graphics*, an OS/2 presentation graphics package that allows you to create presentations simply by filling in the blanks of predesigned templates. A key feature, SmartMaster, provides 30 sets of nine-page presentation templates which can be modified or entirely redesigned by the user. After prompting you to place text or graphics on each page, SmartMaster controls the placement, sizing, and formatting of the given information. You can alter the SmartMaster template at any time; the entire file automatically remaps to the new design.

Freelance Graphics also offers a wide variety of charting options, including more than 50 chart styles and built-in composition schemes. Links to data sources through DDE (dynamic data exchange) enable automatic updating of charts. And integration with Lotus 1-2-3/G, a graphical spreadsheet for OS/2, allows them to share the Graph Tool for added charting capabilities. In addition, *Freelance Graphics* comes with a complete set of drawing and editing tools.

To ensure broad compatibility, *Freelance Graphics for OS/2* imports ASCII, CGM, and Presentation Manager Metafiles, as well as Presentation Manager bitmaps, *Freelance Plus* .DRW and .PFL files, and TIFF files. It exports EPS, CGM, Presentation Manager Metafiles, and *Freelance Plus* .DRW and .PFL files. There is also two-way file compatibility with *Freelance Plus* 3.0/3.01.

List Price: *Freelance Graphics for OS/2*, \$400. **Requires:** OS/2 1.2 or later, 4MB RAM (5MB if you are also running 1-2-3/G or network software or using an 8514 adapter), and a mouse. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 617-577-8500.

CIRCLE 431 ON READER SERVICE CARD



Lotus' *Freelance Graphics* for OS/2 allows you to create presentations that contain both text and graphics.

New&Improved

CONTINUED FROM PAGE 55

Reason Technology Lowers Entry-level Cost Of 80486 PCs

NEW

You can now get a complete 486 system for \$3,995. Reason Technology's new 486 comes with 4MB RAM (expandable to 8MB on the motherboard), an 80MB hard drive, and 1.2MB and 1.44MB floppy drives. Five disk-drive bays and eight full-size expansion slots meet all your expansion needs. The supplied 1,024-by-786 Super VGA adapter sports 512K RAM, expandable to 1MB. Your four grand also buys you a 14-inch color monitor. Reason Technology packages its 486 system with DOS 4.01.

List Price: 486 System, \$3,995. Reason Technology, 290 Coon Rapids Blvd., Minneapolis, MN 55433; 800-542-2049 or 612-780-4792.

CIRCLE 434 ON READER SERVICE CARD

Tri-Star Targets High-End CAD Users

NEW

Manufactured expressly for high-end CAD applications, the 486-based Tri-Cad Ultra 433 comes in a tower configuration. The system, from Tri-Star Computer Corp., includes 4MB RAM, a 64K secondary RAM cache (expandable to 256K), a 200MB hard drive, and 1.2MB and 1.4MB floppy drives. A 16-inch, noninterlaced monitor displays a maximum resolution of 1,024 by 768. The 1MB, 16-bit Super VGA adapter supports 256 colors simultaneously at 1,024-by-768 resolution. The basic configuration also includes two serial ports, one parallel port, and a 12-by-12 inch digitizing tablet.

Buyers can upgrade to a 20-inch color display for an additional \$995 and a Rendition IIV/256 display adapter for another \$695.

List Price: Tri-Cad Ultra 433, \$7,695. Tri-Star Computer Corp., 707 W. Geneva Dr., Temple, AZ 85282; 602-829-0618.

CIRCLE 435 ON READER SERVICE CARD

Super VideoWindows: Low-Cost Multimedia

NEW

New Media Graphics Corp., a leader in PC-based multimedia products, has introduced Super VideoWindows, a full-function video/audio board. Super VideoWindows displays full-motion digitized video in multiple win-

dows. Features include graphics-to-text overlay; image capture, save, and restore; unlimited size scaling; and control over color contrast, brightness, and hue. The \$695 board offers a total palette of 16.7 million colors.

New Media Graphics has also introduced optional companion boards that expand the capabilities of the Super VideoWindows board. The Super VGA Daughter board, with 1MB VRAM, combines with the Super VideoWindows board to provide a compact one-slot solution to your multimedia needs. The Super TV Tuner board, which functions with any video board, allows you to receive television programs and display them in a window.

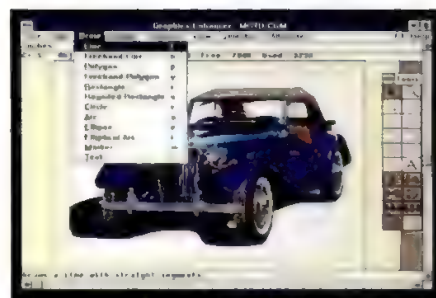
List Price: Super VideoWindows, \$695; Super VGA Daughter, \$395; Super TV Tuner, \$395. **Requires:** Windows 3.0 or NewWave 3.0, later versions of DOS; VGA, or multi-scanning monitor. New Media Graphics Corp., 780 Boston Rd., Billerica, MA 01821-5925; 800-288-2207 or 508-663-0666.

CIRCLE 436 ON READER SERVICE CARD

Wang Unveils Graphics Enhancer for Windows

NEW

Desktop publishing and word processing users whose software supports CGM graphics might want to add Graphics Enhancer from Wang Laboratories to their bag of tricks. This Windows-based, free-form color graphics design and drawing package lets users create or en-



Wang Laboratories' Graphics Enhancer provides a clip-art library with many images for you to use under Windows.

hance not only their own designs but also graphics that can be imported from packages that use the ANSI/ISO computer graphics metafile format.

Graphics Enhancer generates design elements such as ellipses and polygons, modifies elements by rotation or reshaping, adds perspective to multidimensional images, and changes line styles or widths. Desktop publishers can alter the appearance of text by distorting, skewing, or filling with patterns. A 300-item clip-art library accompanies the package.

List Price: Graphics Enhancer, \$295. **Requires:** 640K RAM, 20MB hard drive, floppy drive, DOS 3.2 or later, Windows 2.1 or later and full Windows 3.0 compatibility. Wang Laboratories Inc., One Industrial Ave., Lowell, MA 01851; 508-459-5000.

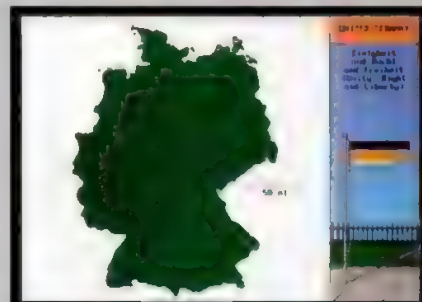
CIRCLE 437 ON READER SERVICE CARD

CONTINUES ON PAGE 58

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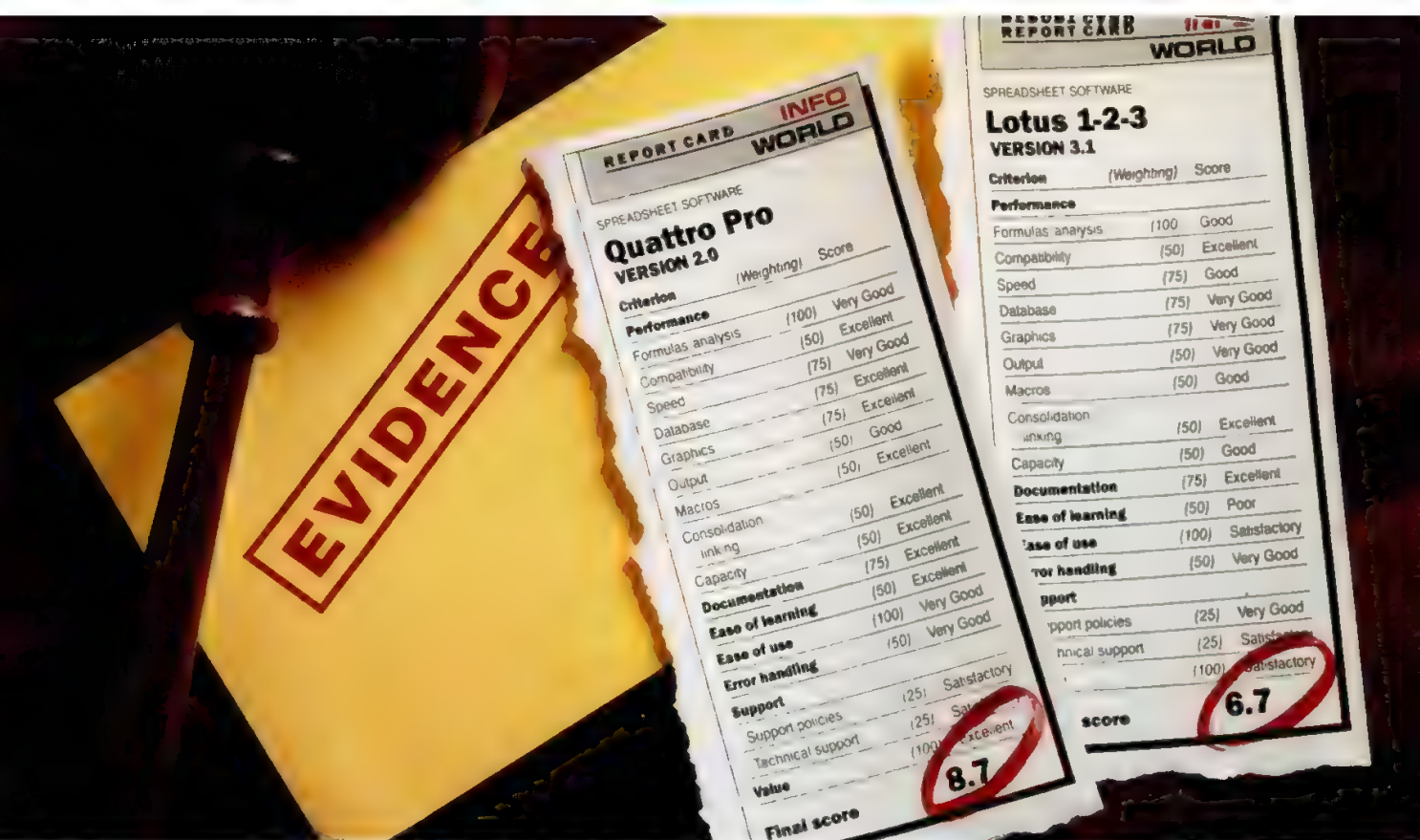
386MAX, Version 5.1—Qualitas's memory management software for DOS can now replace Microsoft Windows' extended memory manager HIMEM.SYS. The \$130 utility uses "instancing," a technique that allows non-Windows applications to run simultaneously in multiple windows without the system crashes and unreliabilities that can result when running large non-Windows-supported programs under Windows. Qualitas uses a portion of Microsoft's VxD (Virtual Device) to ensure full compatibility. In addition, Version 5.1 offers the MAX utilities, which use the LIM (Lotus-Intel-Microsoft) 4.0 expanded memory specification to run programs in EMS outside of Windows, eliminating the need to configure your system separately for Windows and applications that require EMS to manage large data files. Registered users can receive the upgrade free. Qualitas is located in Bethesda, Md., and can be reached at 301-907-6700.

PC Globe, Version 4.0—In addition to enhanced databases, maps, and user configurability, PC Globe's electronic atlas now includes the flags and national anthems of all 190 countries and dependencies profiled. A user-definable currency-rate feature keeps monetary exchange rates current. Version 4.0 has also added major bodies of water and year-round climate information and has increased the number of cities covered. The \$69.95 package even includes comparative data on East, West, and Unified Germany. Maps can be imported to PC Paintbrush, WordPerfect, PageMaker, and Lotus 1-2-3. PC Globe Inc. is based in Tempe, Ariz., and can be reached at 602-730-9000.



Keeping up with global change is part of PC Globe 4.0's mission.

CONTINUES ON PAGE 58



Borland's Quattro Pro is the best spreadsheet.

Quattro® Pro 2.0

"Quattro® Pro provides more features and better performance than 1-2-3..."

BYTE, November 1990

"Quattro Pro offers some of the most powerful charting and best-quality output you'll see in a spreadsheet today."

PC Magazine, December 1990

"Overall, Quattro Pro has the best set of database features we've seen in a spreadsheet."

InfoWorld, December 1990

"Quattro Pro 2.0 also offers more interactive presentations, a more flexible desktop environment and smaller RAM requirements."

PC Week, October 1990

Lotus® 1-2-3® r 3.1

"... only masochists need to try [1-2-3, Rel. 3.1]. Performance was so sluggish on a 1Mb Compaq 386+/20 that we gave up after half an hour."

InfoWorld, October 1990

"... it [Lotus 1-2-3 Release 3.1] doesn't have everything you expect from a graphical interface..."

PC Week, September 1990

"...(1-2-3's) WYSIWYG module has little knowledge of what is going on in the primary program..."

PC Week, October 1990

"While the division of labor is mostly logical, it makes [Lotus 1-2-3's] system feel like exactly what it is: a patchwork."

PC Magazine, December 1990

Lotus users! Save \$395 off Quattro Pro 2.0! If you own Lotus 1-2-3, you can upgrade to Quattro Pro 2.0 for only \$99⁹⁵! This includes our 60-day, money-back guarantee. Order today! See your dealer or CALL NOW 1-800-331-0877

CIRCLE 287 ON READER SERVICE CARD

BORLAND

Makers of Paradox®, Quattro® Pro, Turbo C++, Turbo Pascal® and Sidekick®

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CODE: MB25



New&Improved

CONTINUED FROM PAGE 56

Ready, Aim, File! Puts File Cabinets on Disk

NEW

You can now free yourself from DOS directories and subdirectories with VSoft Systems' new file management software. *Ready, Aim, File!* organizes files logically by content. Its file cabinet metaphor allows you to pull up files contained in folders from one of six color-coded cabinets. When you load a file, *Ready, Aim, File!* automatically runs the corresponding application. File names can have up to 50 characters with full punctuation. In addition, *Ready, Aim, File!* provides three desktop applications—Rolodex, notepad, and calendar; these can be accessed without leaving the working file.

List Price: *Ready, Aim, File!*, \$89.95.

Requires: 640K RAM, 1MB available hard disk space. VSoft Systems Inc., 279 S. Beverly Dr., #318, Beverly Hills, CA 90212; 213-858-3941.

CIRCLE 438 ON READER SERVICE CARD

Executive Technologies Launches Document Management Software

NEW

Designed for use by law firms, corporate legal departments, and the U.S. judicial system, *SearchExpress/Legal* facilitates document management, litigation support, and work-production retrieval. It supports all major local area networks and up to one billion documents which may contain text, data, and/or images. *SearchExpress/Legal* provides access security, automatic word rooting, Boolean searches, and line-level hypertext.

It also searches through its library for all documents containing a given word or phrase and prioritizes them by number of appearances. This allows you to retrieve them in order of presumed relevance.

In addition to the software package, *Executive Technologies* offers an optional module for image scanning and Optical Character Recognition (OCR). The scanned images can be compressed in TIFF Group IV or PCX formats.

List Price: *SearchExpress/Legal*, \$3,995; network version, \$7,500 plus a per-PC charge dependent on network size; scanning and OCR module, dependent on site license. Executive Technologies Inc., 2120 16th Ave. South, Birmingham, AL 35205; 205-933-5494.

CIRCLE 439 ON READER SERVICE CARD

Superlatives Answers "What If" Questions

NEW

Intended for professionals in finance, accounting, manufacturing, and operations, *Superlatives* from Graphicus provides efficient, interactive processes for finding and understanding solutions to business problems. *Superlatives* is a spreadsheet-extension software program capable of automating the search for best results, showing before-and-after comparisons with graphic representations, and stressing advantages and disadvantages to alternatives. It works with .WK1 and .WKS files to communicate with spreadsheet programs.

List Price: *Superlatives*, \$295. **Requires:** DOS 2.0 or later. Graphicus Inc., 150 Lake St. South, #206, Kirkland, WA 98033; 206-828-4691.

CIRCLE 440 ON READER SERVICE CARD

Konica Offers Plain-Paper Facsimile System

NEW

By integrating the LP-3110 Laser Printer with the Fax 500/550, Konica Business Machines U.S.A. has created a plain-paper fax machine.

The LP-3110F facsimile system offers all of the features of the Fax 500/550 plus the plain-paper print quality of laser printing. When the laser printer runs out of paper, the LP-3110F automatically prints messages on the Fax 500/550's thermal printer. Under normal circumstances users can choose which printer will output fax transmissions.

Plain-paper transmissions have a maximum resolution of up to 300 by 300 dots per inch, while thermal paper transmissions possess standard fax resolution.

The LP-3110F provides memory and batch transmission, customized TCR and headers, as well as endless, home, and file polling. It also offers user verification stamp and I.D. codes, programmable speed-dial keys, OMR sheets, CCITT error correction mode (ECM), and a 200-number autodialer. Automatic reduction and high-speed remote diagnostics are standard.

In addition, the Fax system serves as a copier that can make up to 99 copies.

List Price: LP-3110F Facsimile System package, \$5,890; LP-311 Laser Printer with Controller Interface, \$2,595; Fax 550, \$3,295. Konica Business Machines U.S.A. Inc., 500 Day Hill Rd., Windsor, CT 06095; 203-683-2222.

CIRCLE 441 ON READER SERVICE CARD

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IMPROVED

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Generic CADD, Version 5.0—To bring better functionality to a wider spectrum of desktop engineers, Generic Software has released *Generic CADD 5.0*. Features added to the \$395 program include 25 undo/redo levels; point-and-click file loading; editing via selection; virtual disk memory up to 10MB; full-associative dimensioning; nested interactive editing commands; proportional text spacing; hatching and filling with curved boundaries; DOS shelling; and HPGL and EPS file support. The level 3 CAD package is available from Generic Software in Bothell, Wash., 206-487-2233.

Easel/Win—Easel Corp.'s graphical application development system for client-server or cooperative processing architectures is now available for *Microsoft Windows 3.0*. The \$7,500 program takes advantage of *Windows*'s interactive data-flow between applications, and offers full support for *Microsoft's SQL Server* and DLLs (dynamic link libraries), as well as a simplified interface to DDE (dynamic data exchange) protocols. In addition to supporting all *Windows* user-interface tools, *Easel/Win* also provides vector drawing tools for creating custom interfaces. Easel Corp. of Woburn, Mass., can be reached at 617-938-8440.

RM/COBOL-85, Version 5.1—File-access problems for networks running COBOL applications are a thing of the past with Ryan McFarland's *RM/COBOL-85* for *NetWare*. Version 5.1 provides transparent access to Novell Btrieve files using standard COBOL syntax. The product also gives access to indexed files created in other languages, and brings full Btrieve functionality to COBOL applications running under *NetWare*. *RM/COBOL-85* for *NetWare ELS2* retails for \$1,545, \$1,945 for *NetWare 286* or \$2,245 for *NetWare 386*. Runtime versions are available for \$295 (*ELS2*), \$695 (*NetWare 286*) or \$995 (*NetWare 386*). Contact Ryan McFarland Inc. in Austin, Tex., at 800-762-6265.

PI Edit, Version 4.0—The Iliad Group's software development environment for DOS now supports C, C++, dBASE, and Pascal. A quick search utility called *TAGS* has been added for C and C++ development. *TAGS* offers quick reference to functions and other program

CONTINUES ON PAGE 60

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*Paradox SQL Link (\$495 suggested retail) is an add-on product for Paradox 3.5 and is required to make the connection with SQL servers. **Microsoft, IBM, Oracle and DEC RDB/MS servers supported now. Offer also good for owners of any version of dBASE. †Database. Proof of ownership is required. Satisfaction guaranteed or your money back. Upgrade offer expires March 31, 1991. Upgrade pricing good in U.S. and Canada only. Mail orders to: Borland International, Inc., P.O. Box 660001, Scotts Valley, CA 95067-0001. Add \$9.00 for shipping and handling. Residents in CA, CT, GA, IL, MA, MI, MN, NY, OH, PA, TX, VA and WA, please add appropriate sales tax. For orders outside the U.S., call (408) 438-5300. 386 and 486 are trademarks of Intel Corporation. Copyright © 1990 Borland. All rights reserved. B1 1/90

New&Improved

CONTINUED FROM PAGE 58

Zoltrix Debuts Pocket-Size Fax/Modem

NEW

The ZoFAX 96/24P, from Zoltrix is a pocket-sized, external 9,600-bps fax/2,400-bps modem designed for desktop or laptop PCs. Measuring 2.75 by 5 inches, the tiny ZoFAX sends to and receives from CCITT Group III facsimile machines. Background receiving allows you to run application programs while receiving a fax. Features include auto-answer, auto-redial, mail merging, distribution lists, printing and saving of incoming faxes, time scheduled transmission, multiple file transmission, and rotation of fax pictures.

List Price: ZoFAX 96/24P, \$350. Zoltrix Inc., 41394 Christy St., Fremont, CA 94538; 415-657-1188.

CIRCLE 442 ON READER SERVICE CARD

Portable Hard Drive Has 425MB Capacity

NEW

The Mega Drive MDS-P425 is a portable, high-capacity, 3.5-inch hard disk drive designed to work with Mega Drive Systems' one- and two-slot base units. At 2.5 pounds, the 425MB hard disk module measures 2.0 by 4.3 by 7.4 inches. The MDS-P425 is a SCSI drive with the traditional Winchester hard disk design. High-performance shock absorbers, fan system and caching add to its list of features.

List Price: MDS-P425, \$2,087. Mega Drive Systems, Inc., 1900 Avenue of the Stars, #2870, Los Angeles, CA 90067; (213) 556-1663.

CIRCLE 444 ON READER SERVICE CARD

Sculptured Full-travel Membrane Keyboard

NEW

Best known for its mechanical and membrane keyboards, NMB Technologies has produced a new sculptured keyboard with full-travel membrane keyswitches. The 101-key design is optimized for quality performance in advanced network and high-speed PC environments. NMB claims compatibility with memory resident software packages and networking systems such as Novell.

List Price: Sculptured Keyboard, 50-piece orders at \$30 each. NMB Technologies Inc., 9730 Independence Ave., Chatsworth, CA 91311; 818-341-3355.

CIRCLE 445 ON READER SERVICE CARD

GenSTAR 2000 CD-ROM Breaks Price Barrier

NEW

High-quality and low-cost distinguish Genesis Integrated Systems' external CD-ROM drive. At \$499, the GenSTAR 2000 comes complete with interface card, signal cable, system software, audio software, and disk caddy. Measuring 2.6 by 13.8 by 11.2 inches

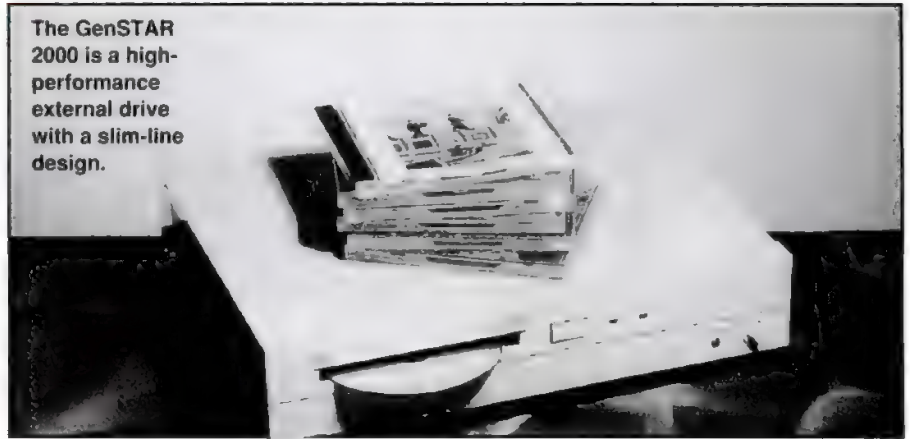
(HWD), the GenSTAR 2000 is capable of eight-drive daisy-chaining and has headphone and dual line-out audio jacks.

According to Genesis Integrated Systems, the CD-ROM drive's average access time is 500 milliseconds.

List Price: GenSTAR 2000, \$499. Genesis Integrated Systems Inc., 1000 Shelard Pkwy., Minneapolis, MN 55426; 800-325-6582 or 612-544-4445.

CIRCLE 443 ON READER SERVICE CARD

The GenSTAR 2000 is a high-performance external drive with a slim-line design.



IMPROVED

CONTINUED FROM PAGE 58

elements, easing navigation through large programs. Single keystroke Make, Link, Debug, and Execute functions have also been added. Improved memory management allows *PI Edit* to take advantage of EMS. In addition to the \$195 DOS version, a \$249 OS/2 edition is available. Direct inquiries should be made to The Iliad Group of San Francisco, Calif., at 800-473-2053.

The Major BBS, Version 5.20—Galacticomm's multiuser electronic BBS now offers improved remote SysOp support and automatic messaging both to and from new signups. The program, available in a two-user configuration for \$59, can be configured to support up to 256 simultaneous users. The standard edition includes electronic mail, real-time teleconferencing, special interest group messaging, file areas, classified ads, and questionnaires. Additional modules include a file library, an entertainment area, a shopping mall, and a menu manager. Galacticomm is located in Ft. Lauderdale, Fla., and can be reached at 305-583-5990; demo BBS 305-583-7808.

BUtility, Version 2.0—Smithware's \$129.95 utility now makes it easier to use and create applications for Btrieve, Novell's record management system, by reducing the amount of time and code necessary to add or drop supplemental indexes, copy files following ranged key paths, or modify data field types. *BUtility* 2.0 offers 64K data buffer editing with variable-length record support, better searching, and an improved user interface. Smithware Inc. of Nashville, Tenn., can be reached at 615-352-2221.

Extra!, Version 3.1—The latest update of Attachmate's PC-to-3270 mainframe connection software for *Microsoft Windows* adds speed, printer emulations (for 3287, LU3, and LU1), PS/CICS import/export file-transfer options, and support for DCA's IRMA coax adapter. Contact Attachmate in Bellevue, Wash., at (206) 644-4010.

ESP for Primavera Project Planner—Primavera Systems has added a file-viewing system to its project management system called the *Executive Summary Presentation (ESP)*. The \$195 module allows users who are unfamiliar with *Project Planner* to callup and print schedules, reports, and graphics. *ESP* also provides on-screen previews of updated tabular reports. Primavera Systems of Bala Cynwyd, Pa., can be reached at 215-667-8600.

They Left out Features.... We Left out the **COMMA!!**

The only thing missing...

Is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. **DesignCAD 3D** sells for \$399.00. Period. No Commal

In order to draw the complex pictures shown below it is desirable to have the following 3D features:

- Interactive design with 3D cursor
- Blending of surfaces
- Boolean operations such as add, subtract, and intersection
- Complex extrusions
- Cross sectioning
- Block scaling
- On screen shading
- Shaded output to printers and plotters

All of these competitors left out one or more of these desirable features in their standard package. They didn't forget the most horrible feature - the comma.

DesignCAD 3D offers **ALL** the listed features plus many more!

If **DesignCAD 3D** has the power to create the 3D objects shown below, imagine how it could help with your design project!

DesignCAD 3D sells for \$399. We left out the comma. We didn't think you would mind!



December 11, 1990
DesignCAD 3D, Version 3.1

\$399

AutoCAD rel. 10	\$1,000.00	AutoCAD AEC \$1,000.00	AutoShade \$500.00
CADKEY 3.12	\$1,000.00	Solids \$995.00	IGES translator \$1,995.00
DataCAD with DC Modeler	\$2,000.00	DataCAD Velocity \$2,000.00	
DesignCAD 3D ver. 2.8	\$1,000.00		
MaxxiCAD 1.02	\$1,000.00	N/A	
Mega Model	\$1,000.00	MegaDraw \$195, List \$295, MegaShade \$395	
MicroStation PC 3.0	\$1,000.00	Customer Support Libraries \$1,000.00	
ModelMate Plus 2.8	\$1,000.00	N/A	
VersaCAD Design 5.4	\$1,000.00	N/A	

Source: Byte Magazine

BYTE MAGAZINE SAYS...

"At \$399, DesignCAD 3D was the least expensive package we saw, yet it was one of the more powerful. ...Don't be fooled by the remarkably low price, this program can really perform!"

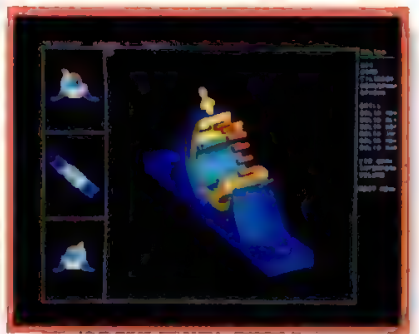
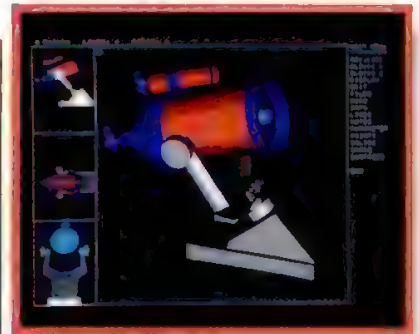
Complete 3-Dimensional design features make it easy for you to construct realistic 3-D models. With full solid-object modeling capabilities you can analyze your drawing to determine the volume, surface area or even center of gravity! **DesignCAD 3-D** even permits you to check for interference between objects! Aeronautical Engineers can now find the center of gravity for a new airplane design with a couple of keystrokes. The Architect can determine the surface area of a roof for decking in a matter of minutes. The Civil Engineer can calculate the volume of a lake or dam in seconds. The Mechanical Engineer will know for sure if certain parts fit together without interference. The uses for **DesignCAD 3-D** are only limited by YOUR imagination!

HOW DO I GET ONE?

DesignCAD 3-D and **DesignCAD 2D** are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. All you need to run **DesignCAD 3-D** is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free information and a demo disk are available by faxing (918) 825-6359 or telephoning:

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The Tempo LX not only lets you work better, it lets you work longer. When not in active use, the LX enters

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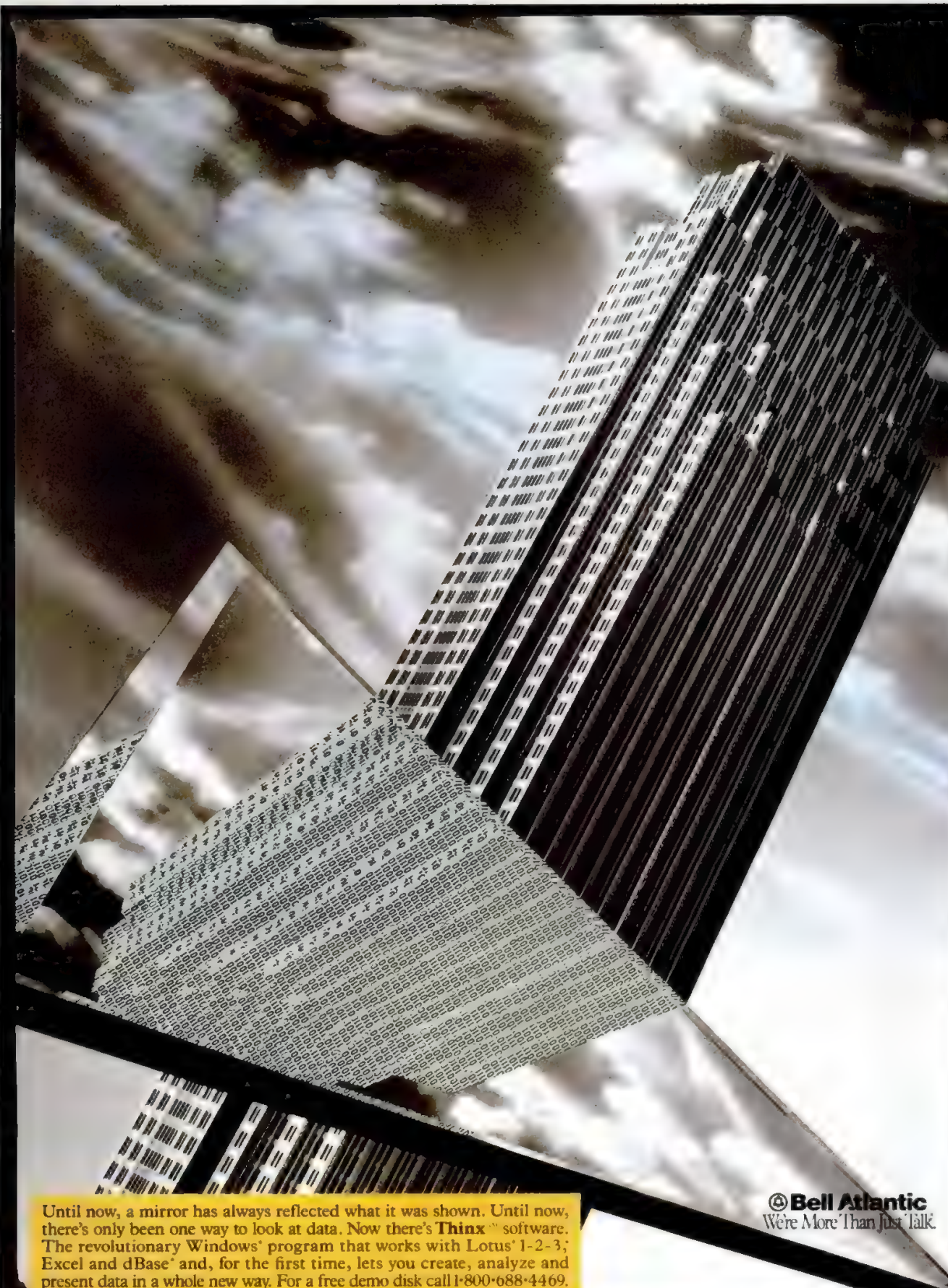
which offer the kind of uncompromising quality, reliability and service you've come to expect from Everex.

Pick one up at an Everex Reseller near you. To find out where, call 1-800-437-EVER. Outside the U.S., call 415-498-1111 or FAX us at 415-651-0728.

After all, if you want a great deal in a notebook, this Tempo can't be beat.



CIRCLE 340 ON READER SERVICE CARD



Until now, a mirror has always reflected what it was shown. Until now, there's only been one way to look at data. Now there's **ThinX**™ software. The revolutionary Windows® program that works with Lotus® 1-2-3, Excel and dBase® and, for the first time, lets you create, analyze and present data in a whole new way. For a free demo disk call 1-800-688-4469.

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We're More Than Just Talk.

edited by
Matthew J. Ross

Read Only

Reviews of the Latest Books for the PC User

Inside the Red Box

■ *Novell NetWare: The Complete Reference*

by Tom Sheldon

Osborne McGraw-Hill, \$39.95

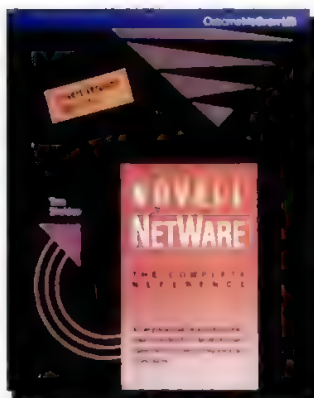
Any book that proclaims itself as "The Complete Reference" to anything risks being charged with hyperbole in the first degree. When the topic is as broad as Novell NetWare, credibility is stretched even thinner—especially when it covers all current versions from ELS Level 1 through NetWare 386.

The big surprise is that the book is up to the challenge. Granted, it takes 700 pages for this hefty tome to provide the comprehensive coverage demanded by the topic, but it gets the job done.

Sheldon's book starts with sections on the different versions of NetWare, cable topologies, and strategies for selecting network hardware and making layout decisions. It covers management and security issues, with clear explanations of the complex interactions between users and groups. The author also demonstrates lessons learned from real-world installation experiences; he stresses the importance of making contingency plans to cover any emergency.

While there are detailed instructions for installing NetWare, and tips to streamline the process, the bulk of the book is devoted to issues related to the ongoing maintenance of your Novell network. Topics are divided into logical functions and placed in separate chapters where each command and option gets detailed coverage.

Some things you just won't find in this book, but to the



The Complete Reference is exactly that, a thorough look inside NetWare.

author's credit, the book clearly recommends that you "refer to your NetWare owner's manual" or contact "your NetWare dealer." These do little to detract from the power and convenience offered by this excellent reference guide. The title's overstatement can be easily forgiven in light of the valuable information Sheldon's book delivers.—**Alfred Poor**
Osborne McGraw-Hill, Berkeley, CA
94710, (800) 227-0900
ISBN: 0-07-881594-0

CIRCLE 401 ON READER SERVICE CARD

■ *Quick Guide to NetWare for the System Administrator*

by Carolyn Jorgensen

A Brady Book, Simon & Schuster, \$24.95

Jorgensen's *Quick Guide* is designed to help you save time by combining NetWare's manuals into one reference guide, while providing other useful information about maintaining your network.

Quick Guide is separated into three parts. Section one consists of a general discussion of networks and NetWare. This section proves confusing at times since many of its

diagrams are on different pages than their respective text references, forcing you to turn pages back and forth.

Part two covers NetWare basics and management tasks. This section, like Sheldon's *The Complete Reference*, is organized by function rather than alphabetically, a nice feature when you are unfamiliar with all of NetWare's options. The third section gives you particulars on the physical hardware and software installation of workstations.

Jorgensen also provides forms in the back of the book to aid you in the documentation of your network. Since LAN setups can change daily, you're better off using the forms as guidelines for electronic templates that can be updated easily.

This book accomplishes what it sets out to do:



providing an all-in-one NetWare reference guide. *Quick Guide to NetWare* only covers through Version 2.15, so NetWare 386 users should look elsewhere. Also, much of the information is presented in a tutorial-like manner which may prove annoying as you become familiar with Novell's commands. I wouldn't recommend this one to more demanding users, but for \$24.95 you do get a 276-page book that will significantly reduce the time you have to search through Novell's manual library. Just for that it's worth the price.—**Wendy Dugas Pérez**

Simon & Schuster, New York, NY
10023; (212) 698-7000
ISBN: 0-13-199977-X

CIRCLE 402 ON READER SERVICE CARD

■ *Executive Guide to Local Area Networks*

by Wayne Rash, Jr. and Peter R.

Stephenson

COMPUTE! Publications Inc., \$18.95

It's called an "Executive Guide," but don't let that fool you. Rash and Stephenson's book is geared more toward the manager or administrator who will be directly responsible for the planning and installation of a LAN.

Unlike the other two books covered in this issue which are NetWare-specific, *Executive Guide* is divided into several



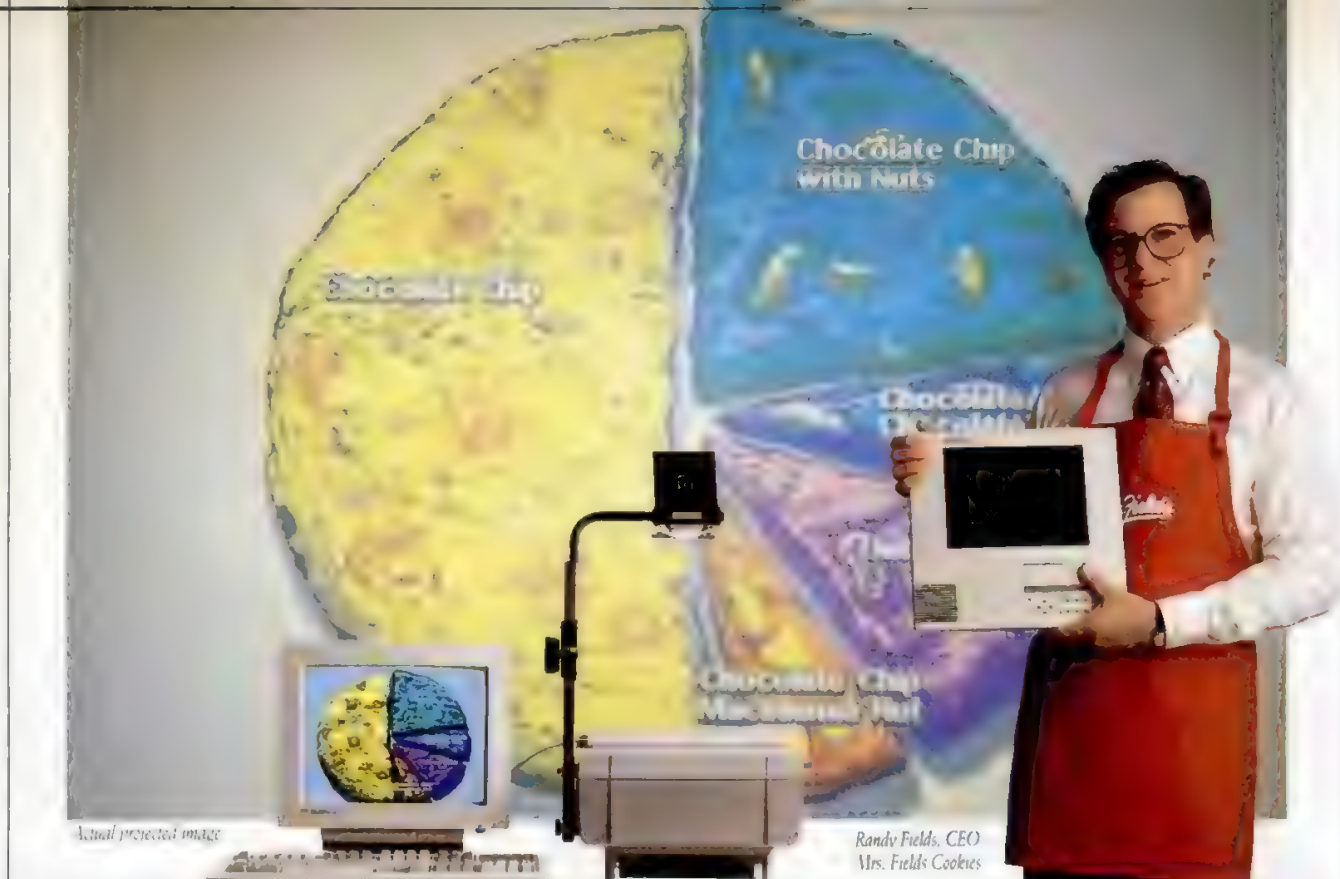
major sections covering every factor involved in the decision-making process regarding LANs. Topics covered include business implications, costs versus benefits, physical requirements, application software, and even LAN alternatives, as well as the technical information to help you make intelligent decisions.

Unfortunately, several aspects of the presentation are already out of date. For example, 16-megabit-per-second Token-Ring is given only a few, inadequate sentences. Overall, the 197-page book is comprehensive, moves along at a quick pace, and its general approach to networks make it recommendable to anyone installing a network. Since the book doesn't cover anything after your LAN is installed, you will need more reference materials in your library, but the *Executive Guide* is a good start.—**WDP**

COMPUTE! Publications Inc.,
Greensboro, NC 27403; (919) 275-9809

ISBN: 0-87455-213-3

CIRCLE 403 ON READER SERVICE CARD



With the Proxima Data Display VersaColor, Mrs. Fields can see how the cookie crumbles.

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"And we get this real-time window on our world without having to squeeze our management group around a desktop monitor. We can roll up our sleeves for intensive work sessions – for reviewing sales data, for exploring 'what-if' financial scenarios, even



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Pipeline

A Look at the Trends Shaping the Personal Computer Market

Object-Linking Spec Will Give Windows Programs a New Way to Share Data

In recent years, software developers have been trying to discover easy ways to create compound documents.

There have been several efforts to establish protocols for linking parts of a file, so that users could prepare a complex document without going through laborious export-import machinations.

Once these data links are established, one benefit would be not having to perform format conversion. Disk storage space would also be saved; revisions will need to be done just once; and there's a guarantee that you're always using the most recent copy of the data.

The planning stages for such a specification are finally over, and the work of putting these links into place has just now begun: Microsoft has started

shipping the Object Linking and Embedding (OLE) library for Windows.

OLE is a set of guidelines for programmers to follow in establishing program code as an object that other Windows programs will be able to execute.

Windows applications that conform to OLE will be able to communicate with other OLE programs interactively so that work performed on a linked portion of the document is treated as a part of the original application.

For example, a spreadsheet could use text that was created in and still controlled by a word processor. When the spreadsheet user wanted to make changes to the text, clicking on the text would send a message to the original word processor that it should load itself into memory.

Or, the word processor might have a "linking" window that would pop up to provide a small set of editing features, saving memory.

Applications developers could choose to implement the protocol using either method.

OLE uses the messaging system within Windows; this will greatly enhance the functions of the Windows Clipboard. OLE also builds on the basic concepts used in DDE (dynamic data exchange).

One of the goals is to reduce today's two-step cut-and-paste operation with a simpler drag-and-drop. Instead of marking a block, cutting it to the Clipboard, and then pasting it at the new location, you'd simply mark it and then paste it.

The new specification was well received by Lotus and Aldus, who had devoted a lot of development time to promoting the concept under the name of Compound Document Protocol (see Pipeline, January 15, 1991).

The next release of *Lotus Notes*, which is nearing completion, is expected to conform to the specification.

Programs written for the specification should be able to use OLE under Windows 3.0; Write, Paintbrush, and Cardfile in the next release of Windows (due out midyear) are likely to have OLE functions.

Microsoft announced that its recently released presentation graphics program, *PowerPoint*, already embodies some of OLE. The next release of *Microsoft Excel*, due out in several weeks, will be fully compliant.

Micrografx and DaVinci Systems say they plan to begin incorporating OLE into their products immediately.

Microsoft, which gave the libraries to programmers who attended a December seminar,

says it will include the needed files and documentation in the next release of the *Windows Software Developer's Toolkit*.

Although software vendors were generally pleased to finally have a completed protocol to use, some smaller developers have expressed concerns about a potential conflict of interest since the guidelines were created by the applications division at Microsoft rather than the systems engineers.

SOUND BLASTER HAS FOOTHOLD EDGE AS MULTIMEDIA STANDARD

Multivoice MIDI products will be at the center of the coming multimedia explosion, but a small company has succeeded in getting its own inexpensive digital sound board noticed.

Creative Labs' Sound Blaster is being adopted by several presentation graphics companies as the medium for generating sound files that the programs can tie in to slideshows.

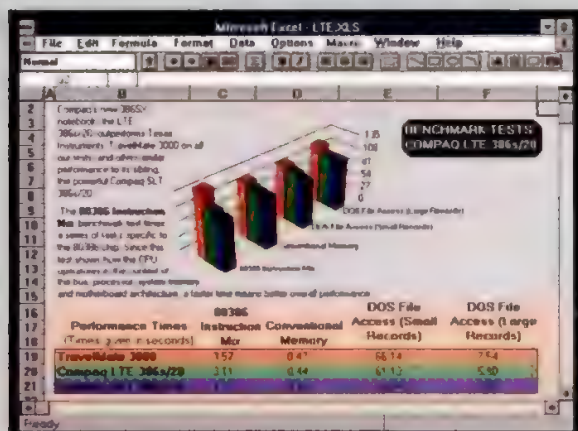
IBM has added Sound Blaster support to its latest upgrade of *Storyboard*, and now Paul Mace Software says that the next version of *Grasp* will be able to read the Sound Blaster's .SND file format.

The Sound Blaster technology is clearly an interim solution since it requires about 600K of disk space to store one minute of sound and does not have MIDI's richness.

It's become popular because—at \$199 after discounts—the board is the least-expensive way to add store-and-record audio to software.

A variety of games, including the popular *Where in the World Is Carmen Sandiego? Deluxe Edition*, use the board to generate realistic human voices and special effects.

CONTINUES ON PAGE 69



Microsoft Excel 3.0, due to ship in January, will be the first application to be fully compliant with the OLE specification that will make compound documents far easier to manage.

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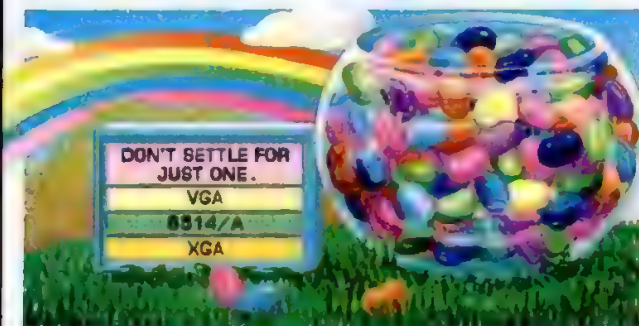
reliable. It has fewer parts and that leads to fewer problems—it's that simple.

Add to that a striking contrast-enhancing background and you'll experience clarity and color richness like you've never seen.

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The IBM 8515 Display: now all the reasons to choose it are perfectly clear.

Find out more. Contact your IBM Authorized Remarketer or marketing representative. For a remarketer near you, call 1 800 IBM-2468, ext. 913.



(Actual unretouched screen.)

Pipeline

CONTINUED FROM PAGE 67

The transition from recreational to corporate use comes not a moment too soon for the Sound Blaster.

The Sound Source, a \$30 sound processor box that patches into a PC's parallel port, is well on its way to becoming the standard for recreational PC audio.

Disney is packaging the Sound Source with its line of PC games and, for most home users, the quality of sound is the perfect complement to a mixed-use family machine.

TOSHIBA PUSHES STATIC RAM SPEED TO 15 NANOSECONDS

Toshiba says it has bettered the speed record for static RAM chips by more than 25 percent.

The new SRAMs are rated for 15-nanosecond access and have a data path of 16 bits.

Each chip contains 6.3-million elements, including transistors and resistors.

Toshiba said it was also planning to build a new factory for producing 4-megabit DRAMs in Japan.

The Yokkaichi facility should be on-line by March 1992 and will have the capacity to produce 3.5 million chips monthly.

In announcing the investment, Toshiba said it expects the worldwide demand for 4Mb chips to reach 120 million chips annually by 1992.

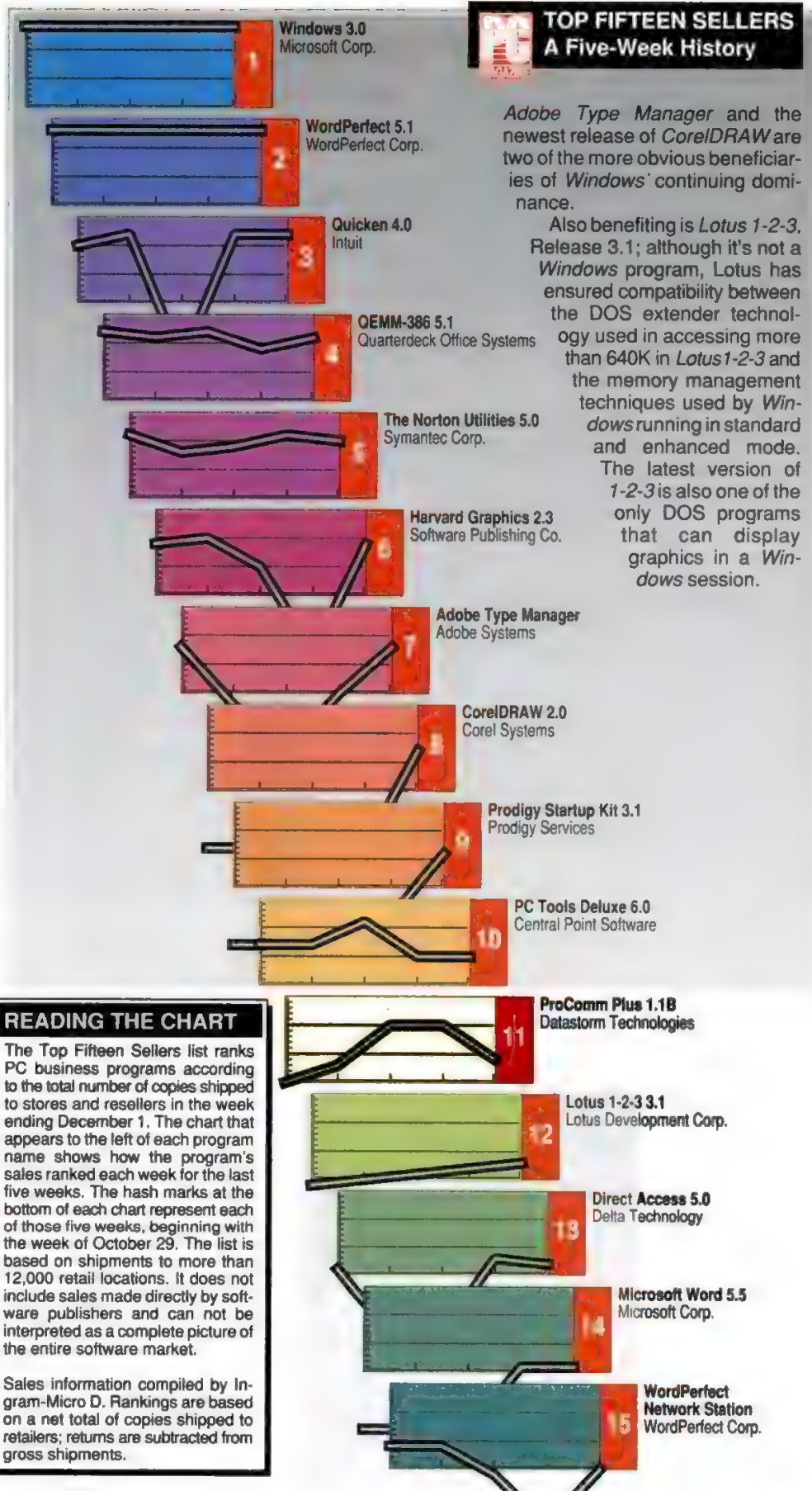
Toshiba estimates that 20 million 4Mb chips were sold throughout the world in 1990.

ASHTON-TATE COMPLETES DBASE IV FOR DEC VMS

Ashton-Tate reached a major milestone in its program to make dBASE platform-independent.

In December, it shipped dBASE IV for VMS, claiming that the software was a full implementation of dBASE IV 1.0, and that it would run applications developed on a PC without modification.

The VMS version is being sold by Digital at an introductory price of \$995 for single-user copies, and \$4,200 for a four-user license.



Great price.

Dot matrix printer \$549.



Everything you
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\$549. HP DeskJet 500.

THE FACTS ABOUT COAL

Coal is derived from the tissues of plants that flourished several hundred million years ago in swamps. As generations of plants grew and died, their debris accumulated as peat until in many areas it was several feet thick. Such areas sometimes subsided for long periods beneath shallow seas. Sediments settling on the sea bottom formed sandstones and other sedimentary rocks. Their weight compressed the peat and converted it into coal. This cycle might be repeated several times, forming layer upon layer of fresh peat material.

Coal is by far the most abundant fossil fuel within the U.S. and the entire world. With continuing growth in population and energy use, it has been speculated that this coal could meet the growth in energy demands all the way until the year 2000, with reserves for 150 years.



A continuing source of fuel for the world.

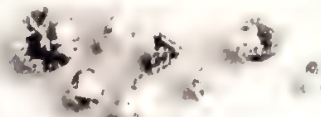
Coal has been used frequently by man since prehistoric times. But coal mining itself did not become a major industry until the late eighteenth century and the industrial revolution. Today, there are four types of coal mining procedures mainly used within the U.S. and other countries. Coal that lies sufficiently near the surface is simply Surface Mined by removing the overlying layers of rock. A Slope Mine is utilized when the coal seam lies at moderate depths. An opening that slopes gently permits easy haulage from the mine. Coal that lies deep beneath the ground is reached by steeply sloping or vertical openings called Shaft Mines. Drift Mining is a method used mostly in tough and rugged terrain. In many of these difficult cases, the seam of coal lies along the surface of the earth, completely out in the open and can thus be mined directly.

Great looking.

Laser printer \$1495*.

WHAT YOU NEED TO KNOW ABOUT DIAMONDS

Diamonds are universally recognized as chief among precious stones; they are the hardest, most imperishable and also the most brilliant of minerals. These qualities alone have made them supreme as a jewel since early times.



DISTRIBUTION

The most important localities for diamonds have been in India, where they were mined from the earliest times until the close of the 19th century. South America, where they have been mined since the middle of the 18th century, and South Africa, in which almost the whole diamond-mining industry has been transferred since 1870.

CHARACTERISTICS

A diamond is almost always found in single crystals which show no signs of previous attachment to any matrix. The stones were, until the discovery of South American mines, almost entirely derived from sands or gravels, but owing to the hardness of the mineral it is rarely, if ever, waterworn.

Some famous diamonds



Flamantine

This pale yellow diamond was acquired in the early 16th century by the Duke of Braganza and later became one of the Austrian crown jewels.



Koh-i-noor

The "Mountain of Light" gem has the deepest vein of a network of all diamonds and has been treasured back to 1304. Purchased by the British in 1849, it was set in the Queen Mother's crown.



Jubilee

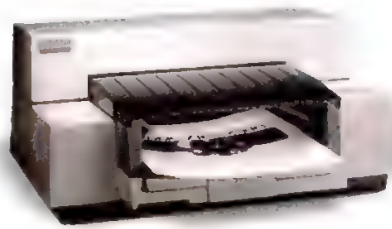
Discovered in 1895, the diamond was named in honor of Queen Victoria's jubilee of 1897.

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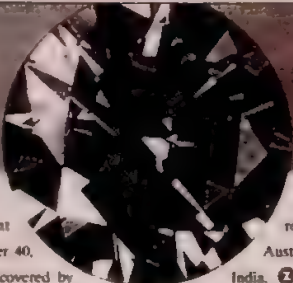
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⑥ As well as a substitute for diamonds, Zirconium is used for new surgical instruments, pins, screws for bone repairs, and ammunition primer.

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Another clear advantage is Charisma's compatibility with Windows 3.0 which conveniently pops hundreds of options on the screen for rapid experimentation. Browse through chart types, clip art, 42 outline typefaces, perspective chart effects, colors, gradients, chart templates, and free form layouts, to name a few.

Charisma also includes drawing tools that will help the

beginner and offer the power user maximum control. So finding the combination that gives your presentation the right snap will be quick and easy.

Charisma can import many other graphic and spreadsheet formats, but more importantly, imported text, charts, and graphics arrive as data and can be further manipulated and incorporated.

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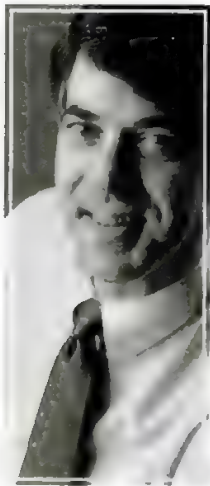
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THE LEADER IN WINDOWS 3.0 GRAPHICS

Bill Machrone



Welcome to Windows; Bring Your Checkbook

Superb capabilities and hidden costs abound in the wonderful world of Windows.

What-you-see-is-what-you-get (WYSIWYG) word processing is the Great *Windows* Promise. Or is it the Great *Windows* Come-on? On one hand you have the graphical interface and all that it confers. On the other, you've got to spend big bucks to get there.

Here's the story: You want to get into WYSIWYG word processing. You've got all the hardware you need, a 386 with a VGA display, a mouse, and the default Hewlett-Packard LaserJet II with a Z cartridge. So you get yourself a copy of *Windows*. At today's prices, it'll only set you back a hundred bucks or so. You know that *Windows* has its own

word processor, Write. How bad could it be? Sure, you can crank out a good-looking business letter, with on-screen fonts that pretty closely match what the printer produces. But that's about it. Beyond some headers and footers, there's not much there.

So back you go to the software store, where you find *Am!*

Professional and *Word for Windows*. They're both powerful products, with more formatting capabilities than nearly anyone but a professional desktop publisher needs. Both have powerful macro languages, support embedded graphics, and let you see what your document looks like as you create it. You pick one, it doesn't matter which. Back at your desk, you install it and set forth to conquer the considerable learning curve. But you've left somewhere between \$300 and \$500 at the store.

Once you get it up and running, you find that you're still limited to the fonts in the HP Z cartridge, which doesn't let you do headlines. You root around on the shelves and find some old downloadable headline fonts that you never got around to installing. After you read the manual, you begin to understand why. It's filled with impenetrable paragraphs describing how to generate the fonts, how to download them, how to tell *Windows* that they're there, and so on. Then you realize that the documentation was written for *Windows* 2.0. You wonder

if it'll even work with *Win 3*. So it's back to the store for the state of the art in fonts.

TOO MANY CHOICES?

You find that there are several ways to go. You can buy downloadable fonts with straightforward install programs that work well with *Win3*. You can buy a headline cartridge, or a PostScript cartridge for the LaserJet, or you can buy a PostScript-compatible interpreter that runs in your PC and sends bitmapped finished pages to your printer. You might opt to bypass the entire PostScript scene with Zenographics' *SuperPrint*, a combination font generator and high-performance printer driver, specifically tailored for LaserJets. Or you can buy Bitstream's *FaceLift*, which not only gives you a wide variety of scalable typefaces but generates screen fonts to match.

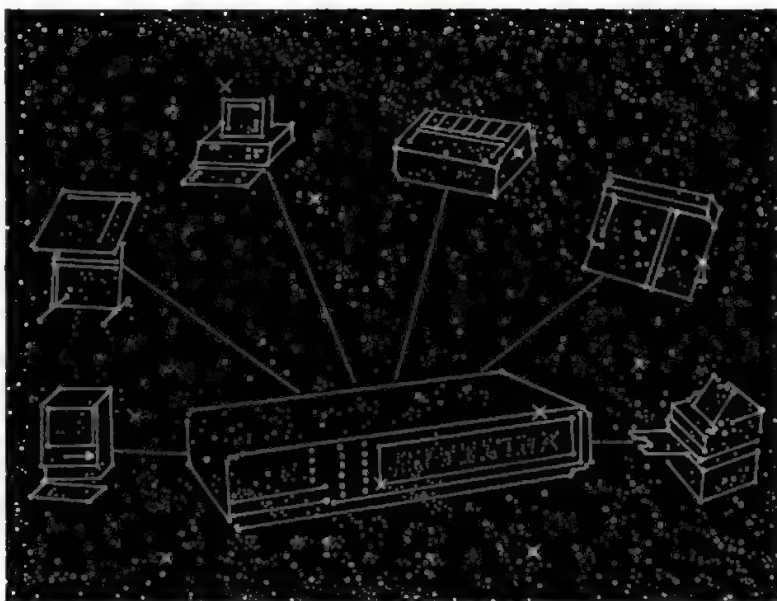
Thus you discover one of *Windows*' central truths: The font representation on the screen actually has nothing to do with the font produced by your printer. They may have sprung from the same file, as with ZSoft's *SoftType*, but more often than not, *Windows* is using a metafont that simply approximates the appearance of your printer font. The tab: anywhere



from \$100 to \$600. Each solution, too, has its own set of strengths and weaknesses, and may or may not benefit from being coupled with one of the other solutions.

Back at the PC, you fire up the font program of your fancy and discover the hidden weakness of on-screen metafonts: Once you exceed 36 points, they look as if they were done by a Crayola and an unsteady hand on even the highest-resolution VGA. Fortunately for your

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Bill Machrone

eyes, if not your wallet, there's a solution. *Adobe Type Manager* takes over the generation of those metafonts, at much higher resolution. And it's only another hundred bucks. Oh, and you'll need the extra-cost supplemental font pack if you want to produce anything besides Times and Helvetica.

NICKELS AND DIMES

You've got to be wondering whether you should have scrapped the PC and bought a Macintosh for your desktop publishing. The *Windows* software industry is nickel-and-diming you to death in \$100 and \$500 increments. I don't quibble with the vendors' desire to make a buck, or deny the genuine need for the products. I question the multiplicity of viable solutions and the varying quality of the results. *Windows* 3.0 extends open-endedness into chaos because Microsoft didn't set firmer standards. Yes, we've all heard about *TrueType* and the incorporation of Adobe Type 1 hinted fonts in a future version of *Windows*. But we've got to use the product now. Half a loaf may be better than none, but it's indigestible if it's half-baked.

Users begin to harbor dark suspicions that Microsoft has carved up duchies and fiefdoms in the *Windows* landscape and traded them for political positions and mutual nonaggression pacts: "You sell 'em such-and-so and we'll support your standard, but we won't build that feature into *Windows*."

Nowhere is the effect more obvious than with the macro recorder. *Win 3* has one, which sets it apart from all previous versions. It has one little shortcoming, though: You can't edit the macros you record. That's fine if you're perfect, and it's great if you never reorganize your desktop. But it stinks for the rest of us. Fortunately, there's a solution. For a mere \$695, you can buy the *Bridge Tool Kit*, which not only edits your macros but greatly expands their power and flexibility. Not surprisingly, it's from The Softbridge Group, the same company that wrote the crippled macro recorder for Microsoft.

When you multiply these expenditures by all the machines in your organization, you have the self-limiting formula for *Windows*' success. I love what *Windows* does for me. But I hate what it costs. ■

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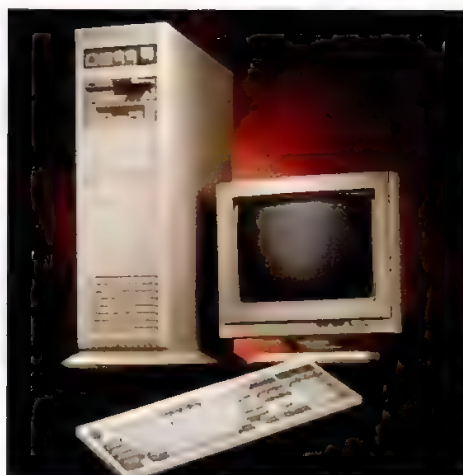
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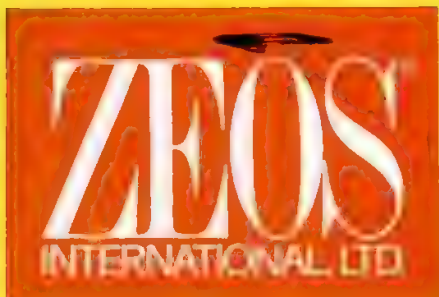
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John C. Dvorak



The Future Of the Virus

A powerful method of coding rests in the hands of pranksters and thieves. It's time to put viruses to good use.

When will the virus designers give up their quest to make the average user's life miserable? Only when the public realizes that their skills are important to the future of computing.

A virus coder tends to be a software purist only interested in taking the machine into unexplored realms. Viruses are very creative, since the best ones need to have both intelligence and transparency. The operator shouldn't be aware that a virus is at work. Meanwhile, the virus is doing chores as a background task.

For a quick review: A virus is self-replicating computer code that winds its way through a system, possibly transferring itself to another system—

infecting it, too. The code tends to be malevolent; it does something bad at some point in time. Typically it erases a hard disk or sends a mischievous message to the user.

But virus code is like any science. It can be used for good as well as evil. The same person who can write a complex virus can write a viruslike utility that will carefully search all the databases in a data library, looking for a single piece of information. Such a virus might be assigned to enter Internet just to find, say, editor-in-chief Bill Machrone's home fax number. A reference to it might be anywhere on the system, in the archives, on a remote machine, or wherever. The fax number is retrieved by what we'll call a "harvester virus" and returned to the source by worming its way back through the network. Many clones of the virus may return the mysterious fax number to the source while others keep looking.

The person who launched the harvester virus can then examine the contents of the harvest. If it's determined that the information is accurate and there is no further reason to continue searching for the same number, a cancellation virus is sent into the system to tell the harvester code to self-destruct. Of course, the original virus is constantly replicating and scrounging throughout the systems. The virus must contain instructions to "check in" somewhere to see if a cancellation message has been sent; otherwise there would be a never-ending battle to kill off all the harvesters. Likewise,

the cancellation virus would have to self-destruct at some point, too, lest it keep reproducing and simply clog up the systems. This is kind of what happened to the Morris virus that ran out of control and jammed up Internet in November 1988.

Unfortunately, with the Morris situation and with most virus concepts, the long-term potential of this kind of code has been overshadowed by the image of bored kids writing shoddy virus programs to harass the everyday user. The panic over viruses makes the public unaware that this kind of computer program is a trend, not a menace.

Of course, a virus could be designed by industrial spies or foreign governments just to suck up data everywhere it can.

TOMMORROW'S VIRUS

This type of virus is an obvious player in the future of computing, especially as machines get bigger and more complicated and users lose control of their own data and fail to perceive the spy within. In a large system where tens of thousands of files exist, a virus could create an encrypted file and pack it with information for years before any suspicion was



ILLUSTRATION NED SHAW

aroused. When the time was ripe, the virus could be triggered to send the data to an interested party. The interested party could be a good guy or a bad guy—a corporate auditor or a corporate raider.

More often than not it will be the raider who benefits if we don't bring the discussion of viruses into the open, make ourselves more aware of security problems, and stop worrying about two-bit vandalism.

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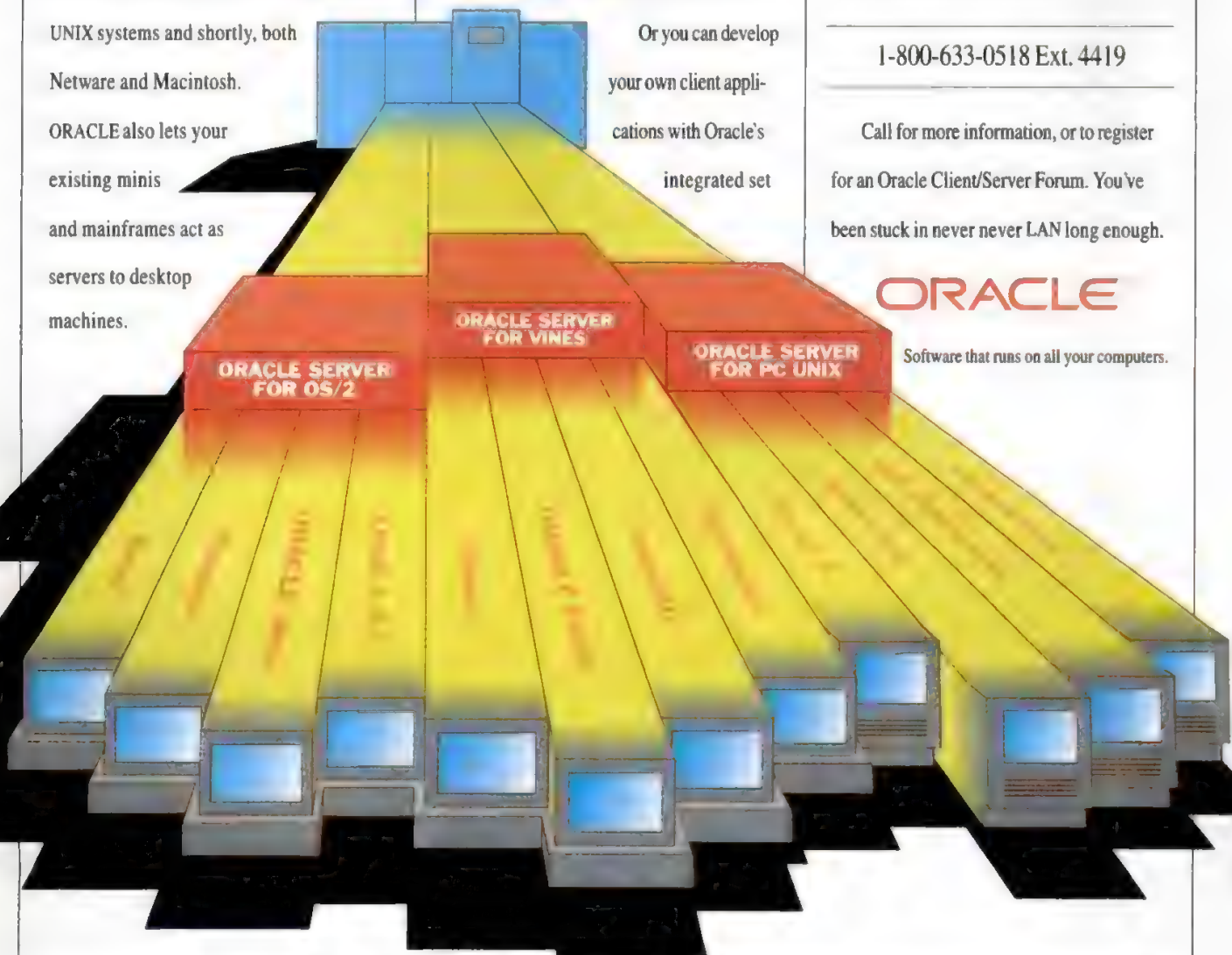
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Inside Track

It's the product of the year. If there is a product of the year for 1991, it's bound to be the **Sound Source** from Walt Disney Computer Software in Burbank, California (818-567-5360). You can **kiss the Roland MT-32**, the Yamaha chips, and every other add-on device good-bye and say hello to the Sound Source, a software implementation of the famous ESS sound chip (with hardware assist). The Sound Source module plugs into a parallel port and delivers 8-bit digital voice to the customer for a list price of \$40—about \$30 in retail computer stores. The adapter directs sound to the speaker while printer data still goes to the printer. This device will become **the new sound standard** for the PC, period. It will pave the way for an entirely **new dimension** of computing.

Let's back up a few clicks. Electronic Speech Systems (ESS) of Hayward, California (415-783-3100) is a group of engineers that developed and patented that **fancy little voice and sound synthesis module** inside those talking books and little key chains that make **explosive** sounds. You push a membrane switch and hear a voice or perhaps a **machine gun**. The key to success is that the data file containing the sound is very compressed. Recently Disney obtained an **exclusive license** to use a software implementation of the technology with the PC. This was done to help popularize a series of **outstanding Disney games** for preschoolers.

I have a five-year-old who adores these games. All the Disney products are **highly recommended** and available at your local computer and software stores. Any store that doesn't carry this stuff is **a store to avoid**. The games using the Sound Source cost \$49.95 each. The Sound Source device is sold separately. Expect to see **all** of the game makers move to this technology within the next nine months.

Genuinely Interesting Hardware Dept.: Ever since the introduction of the Xircom Pocket Ethernet Adapter (which has a DB-25 connector on one side and an **Ethernet connector** on the other), I've expected to see more technologies built into the connector itself. (For example, in the Disney Sound Source mentioned above, the electronics are in the connector.) So from Trantor Systems Ltd. (5415 Randall Pl., Fremont, CA 94538; 415-770-1400) comes **MiniSCSI**. Trantor is normally known for CD-ROM software, and as you know, CD-ROMs run off of SCSI ports. This SCSI adapter allows **laptop users** and other machines with no slots to interface with the CD-ROM (or other SCSI devices) compatible with the implementation. The MiniSCSI costs \$179 and comes with both CD-ROM and hard disk drivers. As I've reported in the column before, the SCSI implementation on a PC might be **problematic** on certain systems, so discuss compatibility with the

vendor. This 2.5-ounce device plugs right into the parallel port and creates a standard SCSI port. Good idea!

Cheap Pocket Guides and Weird Price Dept.: The winner of this month's **Weird Price Award** goes to YP&A for its *Computer Industry Directory*. Selling for the weird price of \$7.46, this little self-published pocket guide is a **handy quick list of important** hardware and software vendors' phone numbers. Call YP&A at 213-874-3843 for a copy.

The book is produced with an **outstanding software program** called *Books, Cards & Labels*, Version 2. This \$129 software package, available at most Egghead stores, allows you to take almost any database file and create an **elegant** little bound book of phone numbers and addresses in a number of formats. It also does mailing labels and Rolodex cards and stuff like that. For more information contact Useful Software in Calabasas, California, at 818-880-9128.

Genuinely Interesting Software Dept.: StarCOM is a \$59.95 utility that allows you to **change each of your internal DOS commands** to a new name, or an alternate name, or even delete the command. This is one of those "cool" utilities that allows you to **customize** your DOS for foreign languages; it even allows you to disable some inadequate DOS features and **substitute a better utility**. For example, you could disable the COPY command and instead have a copy utility resting in the root directory so that when you type COPY you end up running the utility rather than the internal DOS command.

For all those corporate micro managers **worried sick** about some rube **erasing the hard disk** with a FORMAT command, you can simply disable FORMAT or change the command to a new name and have, say, a batch file named FORMAT.BAT that only formats floppies. When the user types FORMAT, the batch program takes over and prevents accidental **hard disk erasure**. There are a lot of uses for a program like this. It works with all DOS versions between 2.1 and 3.3. A version for 4.0 and above is not yet available. Contact Oursoft, P.O. Box 6396, Bellevue, WA 98008-0396; 206-643-0204.

Comdex Report Dept.: In the next edition of Inside Track, I'll cover the Fall Comdex with my yearly list of **overlooked and interesting products** I found in the back alleys of the show. This year the event was bigger than ever, and the town was taxed to the limit. Traffic gridlock outside, long lines, crowded aisles, **gawking foreign visitors**, and a somewhat disorganized show layout made efficiency difficult. It was apparent that the **downturn in the business climate wasn't** expressed by any of the showgoers or the vendors. In fact, everyone said business was booming! The question: Is this good news or the **beginning of the end**? ■

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Jim Seymour



GUIs and Word Processors: Strange Bedfellows

Don't get stuck in the "goosey" world of graphics word processors.

Can we talk? About graphical user interfaces, I mean? For just a few minutes here, without the bombast of the Microsoft PR machine deafening us and without the cant and caustic position-taking that usually takes over conversations about GUIs?

GUIs in general, and *Windows* 3.0 in particular, are swell. Sure, *Windows* isn't the best graphical interface around. It's not even the best-looking: that title is shared by *Open Look* and the NeXT interface.

But it's all we've got. If you run a mid-to-high-level DOS PC, and don't want to fall into the abyss of running your favorite programs under a DOS emulation mode of some version or other of Unix, you're going to use *Windows* 3.0. (Yes, I know about GEOS. Yes, I think it's a great operating environment. But it has been irretrievably positioned at the bottom of the DOS market, a kind of poor man's *Windows*. That's neither correct nor fair, but that's the way it is.)

Some skepticism about the impact of *Windows* might have been reasonable before last May's rollout of *Win 3*, but folks, the battle's over, and *Windows* won. It's the GUI that's going to run on DOS PCs.

But not on *everyone's* DOS PC. And not for every job.

Despite the enormous improvements in Version 3.0, *Windows* is still a long way from becoming Everyman's operating environment. No matter what anyone may tell you, it isn't a piece of cake to install, optimize, or use.

A corporate PC manager who came up to me after a recent speech asked if I'd consider helping him develop a "*Windows Survivors Support Group*" for all the micro managers in the area who'd come to realize (his words) that they'd jumped into the *Windows* era too soon. "Sort of like a support group for families of people who've become addicted to something evil," he said. "How to deal with their behav-

ior, where to get help, that kind of stuff."

I knew what he meant.

Windows can be a black hole for users' time. The time wasted fiddling with WIN.INI files and .PIF files alone is enormous.

Not to be a hypocrite here, I confess that yes, I use *Windows*. Some of the time. But I don't use *Windows* applications all the time, or even most of the time.

Because too often, *Windows* is a counter-productivity tool.

PRODUCTIVITY LOST

Word processing is the classic example of the conflict between GUIs and established norms of productivity, of course. I say "of course" because tens of thousands of other people have noticed this, too—particularly, those who've upgraded to *Word for Windows* or one of the versions of Samna/Lotus's *Am!.*

Pete Rinearson has a great analogy on the path from high-level character-oriented word processors to these new GUI packages. Pete has written the best books on *Microsoft Word*, sells an improved version of the Help file for *Word*, and won a Pulitzer Prize for his reporting on the development of the Boeing 757. He

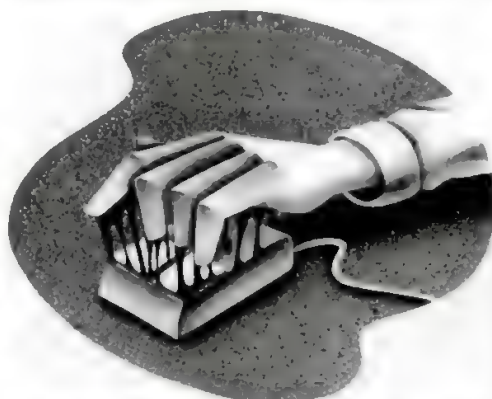
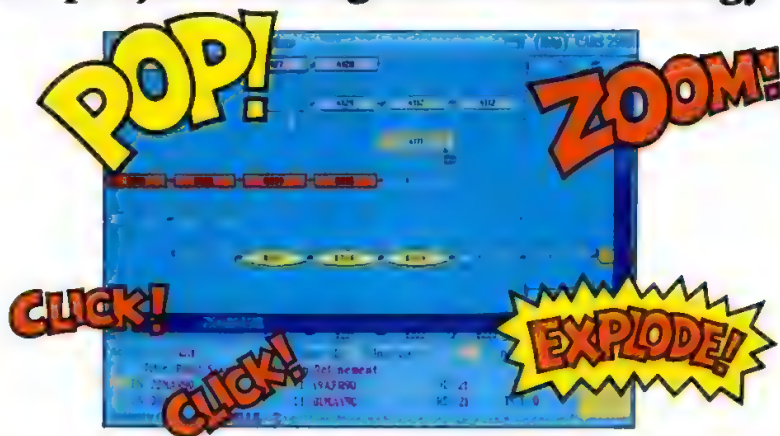


ILLUSTRATION: NED SHAW

knows how to turn an idea as well as a phrase.

Pete likes to say that a user of character-based *Microsoft Word* confronting *Word for Windows* is like a third-grader confronting cursive writing. The *Word* user has suffered through learning a rich and powerful but not exactly intuitive word processor, to be finally delivered into a world of amazing productivity. That user is now asked to forget what he's learned and start over with *Word for Windows*.

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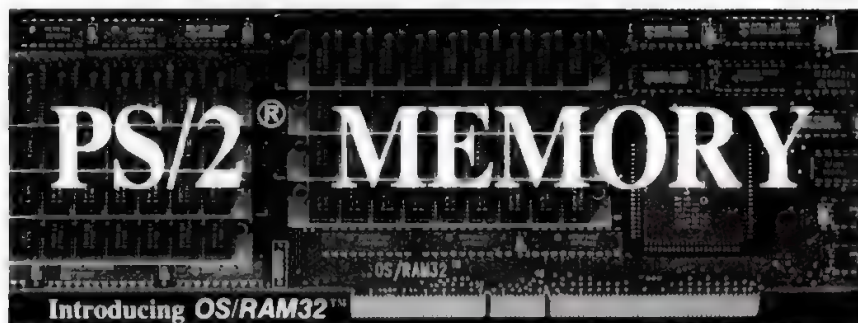
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Jim Seymour

Similarly, the new third-grader who has just struggled through learning to write with block letters is suddenly confronted with a teacher who wants him to forget all that and learn cursive handwriting.

In Pete's words: "One could forgive a kid for asking, 'What's going on here?!?'"

WinWord certainly has its advantages. Its accurate, legible page-previewing system, for example, can save time: no more printing things over and over, trying to get them to look right on paper. The "ribbon" panel for formatting is snazzy, and the Quick BASIC-style macros are powerful, if at first baffling.

But against those advantages you can stack up a long list of penalties for *WinWord*, compared, for example, to Microsoft's own *Word* 5.0.

The most important of which have to do with speed. Evolving over its several versions, *Word* became a phenomenally fast word processor. On everything from a 12-MHz 286 up, it flies. On my current 386 and 486 machines, I actually set its internal cursor speed *down* from its normal setting: sometimes *Word* is *too* fast.

I don't think anyone will ever accuse *Word for Windows* of being too fast. *WinWord* chugs along, screen a-flicker, putting those scrinchy characters on-screen. It's not hard to get ahead of *WinWord*, even if you're just a so-so typist.

WinWord is a great tool for focusing on what the final look of a document should be. But long before we get to the document's appearance, we've got to get its contents into the computer. And that's where GUI word processors fall down: actual production-level work, as opposed to the final presentation of the work.

For now, a state-of-the-art character-based word processing program is a better power tool for the proficient user than a GUI word processor. You can *fly* on a good character-based package. No one flies in the well-named world of "goosey" word processors.

So as much as I may like *Windows* for other work, and as much as we here at *PC Magazine* rave about the GUI-ness of this program or that, keep in mind the real goal of almost every business PC program: getting work done. And consider whether for your needs, a character-based power tool is a better choice than an elegant stone-cutting kit.

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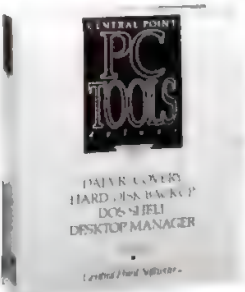
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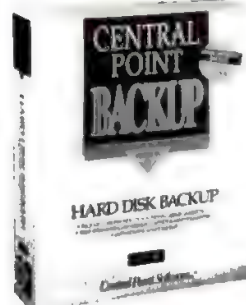
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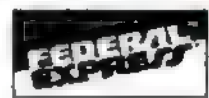
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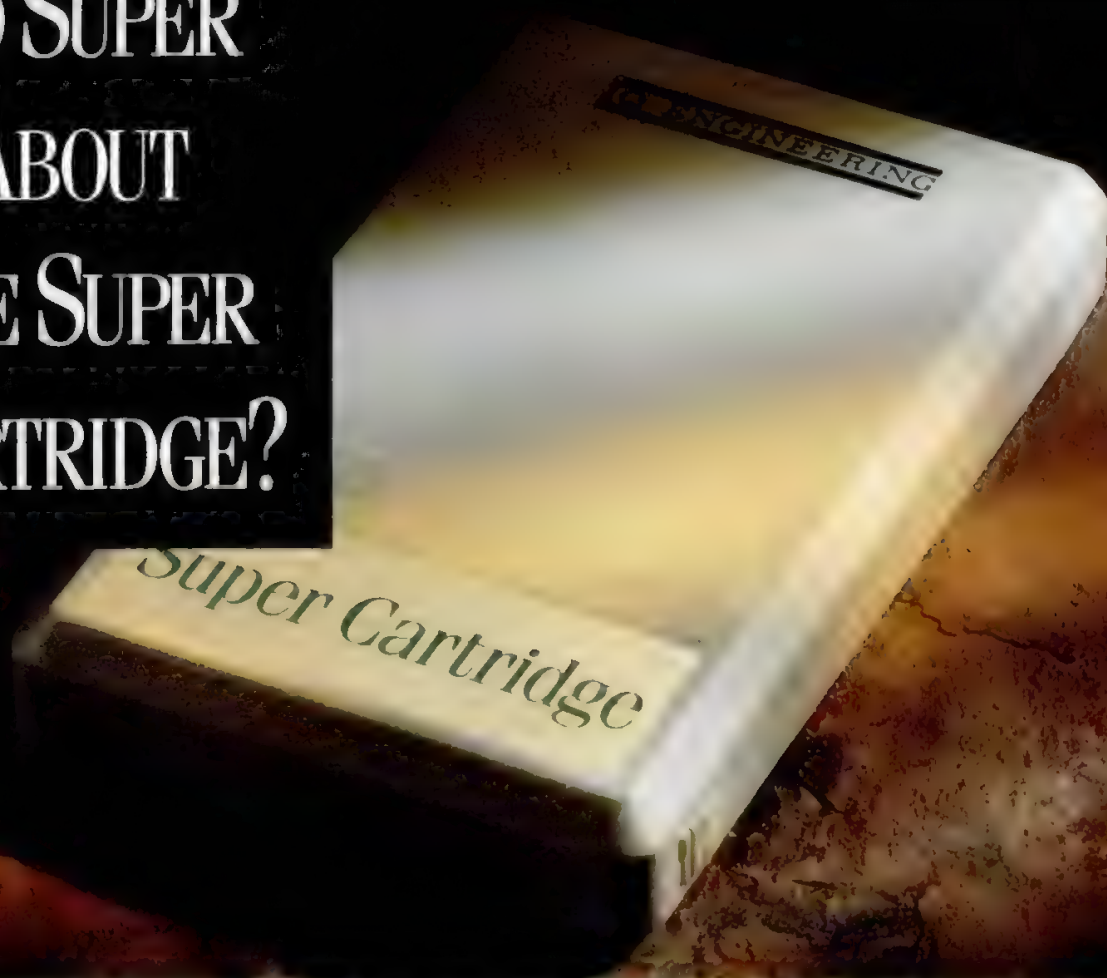
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CIRCLE 325 ON READER SERVICE CARD

William F. Zachmann



Microsoft's OS/2 Promise

Microsoft's continued involvement in future releases of OS/2 is good news for both *Windows* and OS/2 users.

Last September's expanded cross-licensing agreements between IBM and Microsoft marked both a greater acceptance, by IBM, of *Windows* as at least a transition environment and a reaffirmation, by Microsoft, of OS/2 as the ultimate goal. The agreements went a long way toward reconciling the differences that had strained relations between IBM and Microsoft early in 1990. They did not eliminate completely however, differences between IBM and Microsoft regarding their priorities for *Windows* and OS/2. IBM still obviously preferred direct migration to OS/2's Presentation Manager whenever possible. Microsoft, on the other hand, continued to emphasize *Windows*.

Microsoft had for some time encouraged software developers to concentrate on *Windows* products rather than developing for the OS/2 Presentation Manager. Shortly after the highly-anticipated

September 17 announcement of the expanded licensing agreement and reallocation of primary development responsibilities for *Windows* and OS/2, Microsoft explicitly and publicly promised to broaden support for *Windows* applications on OS/2.

Two parts of that improved support had already been announced. First, the *Windows* to OS/2 software migration kit (SMK) was available. The SMK is a tool for translating *Windows* programs into OS/2 Presentation Manager programs by mapping *Windows* application program interface (API) calls to Presentation Manager API calls.

The second part was a strong reaffirmation by Microsoft to provide a binary compatibility layer (BCL) for OS/2 2.0 to permit the direct execution of *Windows* binary programs. While the SMK translates a *Windows* program into an OS/2 PM program, the BCL will give OS/2 the ability to run a *Windows* program interpretively as an OS/2 PM program.

The third part of Microsoft's promises for broader *Windows* support on OS/2 was new: the intention to support the *Windows* API directly on the "portable" version of OS/2.

Windows applications will run on this "future" OS/2, which should not be confused with IBM's Version 1.3, without the inefficiencies of emulation overhead and other potential limitations of the BCL. Microsoft has made it clear that the future "portable" version of OS/2, whose development remained the primary responsibility of Microsoft, would be not only for non-Intel architectures, but would eventually replace the OS/2 1.x and 2.0 versions (for which IBM had assumed primary responsibility) on Intel-based systems, as well.

In fact, Microsoft began referring to what had previously been called either the "portable" version of OS/2, the "future" version of OS/2, or OS/2NT (for "new technology") simply as OS/2 3.0. The messages in that, while in several respects both complex and subtle, are nevertheless clear.

THE MEANING BEHIND OS/2 3.0

First of all, and contrary to some of the more hysterical accounts that appeared in the trade press last fall, Microsoft had no intention of abandoning OS/2. The versions for which IBM assumed primary responsibility last fall were the past (1.x) and present (2.0) versions that



ILLUSTRATION: NED SHAW

were already finished. IBM was merely taking over the mundane tasks of final testing and quality assurance. It was far from "seizing control" of OS/2, as some claimed. Microsoft has assumed the primary responsibility for OS/2 3.0, now under the direction of former DEC VAX VMS developer, David Cutler. Microsoft is more deeply involved in defining the future of the operating system than IBM.

Second, it showed decisively the absurdity

William F. Zachmann

of the "Windows versus OS/2" scenario that some are tempted by even today. Microsoft had no reason to reinvent the wheel by turning a DOS-based *Windows* into a rival to OS/2. The far more sensible course, and the one Microsoft is obviously following, is simply to move *Win-*

dows over from DOS onto OS/2.

For that is exactly what the software migration kit, the *Windows* binary compatibility layer for OS/2 2.0, and the direct support of the *Windows* API in OS/2 3.0 add up to: *Windows for OS/2*. *Windows*, far from being a rival to OS/2, will end up being virtually a part of OS/2.

Microsoft's third and final message behind OS/2 3.0 is that although there is no question of a rivalry between *Windows*

and OS/2, *Windows* may be viewed loosely as a rival to the Presentation Manager, at least from the prospective software developer's perspective.

Given the promise of direct binary support for the *Windows* API on OS/2 3.0, it's possible that a software developer, whether an independent software vendor (ISV) or an in-house programmer, may choose to ignore the Presentation Manager API entirely and simply write to the *Windows* API instead.

Even were that so, it would make relatively little difference to end users, since the "look and feel" of the application would not be affected, only the API used to create it.

Moreover, Microsoft is unlikely to drop support for the Presentation Manager API in OS/2 3.0 as it expands the operating system to support *Windows* API calls. To do so would create some serious compatibility problems given the growing number of PM applications, as well as causing major problems for Microsoft's relations with IBM.

Besides, what the *Windows* API most lacks are precisely those OS/2 services and capabilities already present in the PM API. The PM API provides a more logically consistent model and set of naming conventions. Most programmers experienced with both prefer the Presentation Manager API.

AN OS/2 FUTURE

Precisely how all this will work out depends in part on how the combined *Windows*/PM API in OS/2 3.0 is implemented. It's unlikely that developers will be able to mix *Windows* and PM API calls willy-nilly in the same program, since the two rely on different models for addressing and manipulating the display space. My hunch is that any particular program will have to pick either a PM or a *Windows* mode and stick with it, although a large number of calls may be common to both modes.

In any case, assuming Microsoft keeps its recent promises, the result for users will be a far easier and more natural transition from DOS/*Windows* to OS/2 than most have come to expect. The *Windows* binary compatibility layer in OS/2 2.0 (for which Microsoft remains the primary developer) and the ability to run *Windows* as well as PM binaries directly on OS/2 3.0 will strengthen both *Windows* and OS/2 in the short term while greatly enhancing OS/2's longer term prospects. ■

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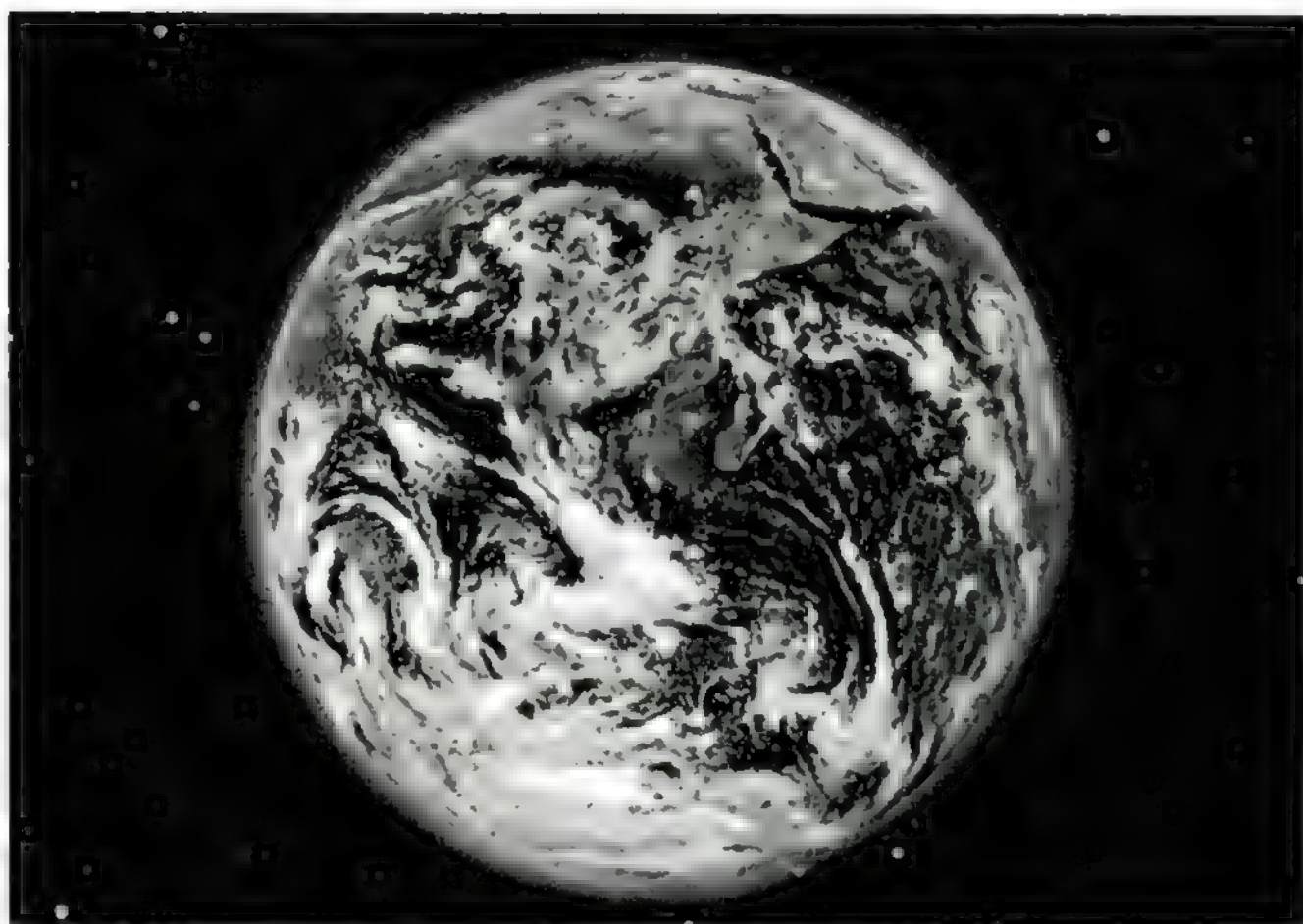
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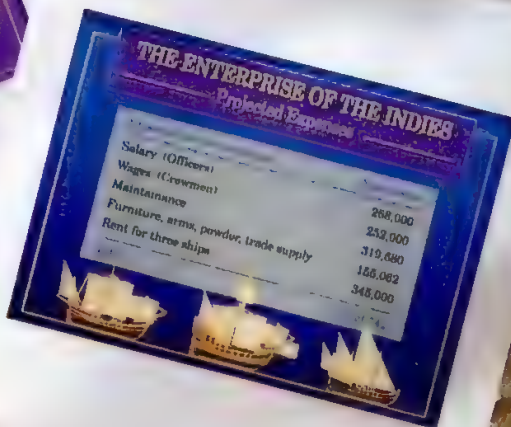
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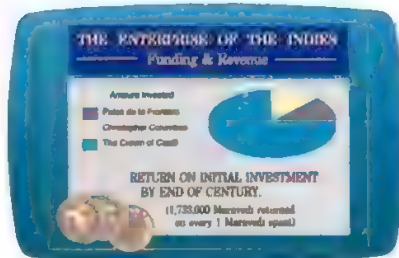
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Maximum Performance

by Jim Seymour

Muscle sells.

That's been the operating premise in the PC hardware business for a decade. The newest, fastest, hottest boxes are the high-flyers, drawing frenzied buyers who throw cash into vendors' open arms. But during 1989, PC manufacturers and resellers saw that conventional wisdom fade. As their hot new 25-MHz 80486-based machines rolled out, customers responded with a yawn.

ILLUSTRATION: GLENN DEAN

According to Storeboard, a market research concern, nationwide sales of 486 PCs through retail outlets added up to just 1,390 machines in August 1989 (the most recent month for which data is available). Of course, a lot of widely respected 486 machines are sold only through the direct-market channel and thus don't show up in Storeboard's counts. But even among the major mail-order houses, 486 sales hardly took off.

At Swan Technologies, CEO Jack Conrad says that by the end of 1989, 486s accounted for only about 2 percent of sales, while sales of 386-based boxes totalled more than 80 percent. Michael Dell reports that 486s represented just 5 to 10 percent of Dell Computer Corp.'s sales, dwarfed by the 75 percent claimed by 386 PCs. And CompuAdd CEO Ed Thomas says 486s constitute less than 3 percent of his company's unit volume. Other direct marketers report similar figures.

One explanation for those slow sales is that the first round of 486 PCs, running at 25 MHz, cost too much and offered too little. A few months back ("The First 24 486/25 PCs: Giant Step or Stepping Stone?," *PC Magazine*, September 11, 1990), we tested 24 486/25s and found that on the average they provided a 10 to 15 percent increase in performance over typical 33-MHz 386 machines—at prices as much as 50 percent higher. It wasn't hard to see why buyers were keeping their hands in their pockets.

Now the advent of 33-MHz 486s is changing the price/performance ratio. Their performance is significantly better than that of 33-MHz 386s, and though there's a premium to be paid for that edge in speed, these new 33-MHz 486s make the 386-versus-486 choice more difficult.

POWER MACHINES FOR DEMANDING APPS

For this review, we gathered 30 33-MHz 486-based PCs for comparison. Anticipating that buyers are looking for machines in this lofty range to use as network servers, as desktop publishing and CAD workstations, and for other demanding applications, we asked for machines set up to meet those needs.

Our standard configuration for these reviews is as follows: an Intel 486 33-MHz CPU, an ISA (AT-style) bus, 8MB RAM, a external RAM cache where available, a 200MB to 300MB hard disk, at least one high-density floppy disk drive, a VGA or Super VGA display subsystem,

and one parallel and two serial ports. Machines had to be standard production models, caching hard-disk controllers were not permitted, and the vendors were asked to provide DOS 3.3 or 4.01.

Although we usually insist on PCs certified to the FCC's Class B standard

**In almost every way,
the 486 is simply a 386
with some external
functions moved onto
the same slice of
silicon as the CPU.**

(suitable for home use), we accepted Class A machines (office use only) for these reviews. At this point, the typical \$5,000-and-up price tags of 486s mean that they aren't likely to appear in many living rooms.

This round of reviews includes machines from ACMA, Amax, Arche, Bitwise, Blackship, Blue Star, Boss, Club American, Computer Market Place, Diamond, Dynamic Decisions, Dyna Micro, Eltech, Fortron/Source, International Instrumentation, Micro Express, Micro Telesis, National Micro Systems, Northgate, Novacor, Panther Systems, PC Brand, PC Pros/Touche, Peregrine, SAI Systems, Standard Computer, Systems Integration Associates, Tangent, Tri-Star, and Twinhead.

WHAT'S IN A NAME?

A good argument can be made that Intel misnamed the 80486 chip and in the process created a problem for itself, its computer-making customers, and a lot of PC buyers. By using the 80486 nomenclature, Intel suggested that the 486 was a new-generation processor. That has contributed to the slow sales of 486 PCs, because in many companies, authorization to buy a new generation of PCs takes a new round of approvals. And in these days of tight budgets and tighter controls, getting those approvals is a tough job.

Intel and its customers might be a bit

better off if the chip had been named something like the "80386M." Why "M"? Because in almost every way, the 486 is simply a 386 with some external functions—notably math coprocessing—moved onto the same slice of silicon as the CPU.

With 386 machines, system designers often added Intel's 82385 cache controller chip, plus a block of fast RAM. With the 486, both the control circuitry and 8K of fast cache memory are built into the chip.

In addition, Intel finally moved math coprocessing onto the CPU chip. Earlier machines included a socket for an optional 80x87 math chip on the motherboard. That chip sped up many math-intensive floating-point operations and was a boon for users of CAD, desktop publishing, and drawing or graphics programs, as well as most statistics packages. A 33-MHz 80387 math chip alone cost \$600 or so.

Now 387-level math coprocessing is built into every 486 chip. In addition, every machine tested in this roundup included a socket for the Weitek WTL4167 math coprocessor. The 4167 operates differently from Intel's coprocessors (and their clones from AMD, Cyrix, and IIT). By using a memory-mapped architecture, the Weitek coprocessors save time, moving both coprocessing instructions and the related data to the chip more quickly. We didn't test our computers' performance with Weitek coprocessors, but experience suggests that adding a 4167 chip will improve the speed of floating-point calculations some 10 to 15 percent over the 486's built-in math coprocessor. Whether that's worth the Weitek's \$1,295 list price is up to you.

CLOSE RACE

Whatever the right name for the 486 chip, one constant became clear in the testing process: These are fast computers. Although some machines inevitably edged ahead of the pack in one performance category or another, we've rarely seen a group of computers with so many of them yielding such close test results.

When the overall performance of a class of competing machines gets this close, buyers tend to look more critically at the subtle design differences among machines and to apply bang-for-the-buck tests that might not otherwise be so important. For example, 26 of these machines used external processor caches, usually

adding 128K of fast RAM for the cache. But four vendors decided that the 8K cache that Intel provided within the 486 chip was sufficient. Arguments about cache size and design continue. (See the sidebar "Processor RAM Cache: Hype or Help?" for a complete discussion of the Cache Wars.)

The inevitable Bus Wars argument also arises here. Some PC gurus have claimed that ISA-bus 486s don't make much sense. They argue that if you're going all out for performance by choosing a 486 processor, you should back up that processor with a 32-bit bus, such as IBM's Micro Channel architecture (MCA) design or the increasingly widespread Extended Industry Standard Architecture (EISA) bus adopted by many of IBM's competitors.

Our tests of these ISA 486s show that there's a lot of life left in the old AT bus: These are hot machines. And remember that a 32-bit bus doesn't help much until you start plugging 32-bit interface cards into those 32-bit expansion slots. At the same time, choosing a machine of this power is a long-term investment, and a great variety of 32-bit cards are coming.

A significant body of experience suggests that for network use in particular, a 32-bit bus combined with multiple 32-bit network adapter cards can make a big difference in throughput. IBM, for example, has argued that bus bottlenecks are the primary factor in limiting network performance today. Big Blue backed up that argument last summer by introducing an MCA-bus server using the 386SX chip—a much less powerful CPU than these 486s.

Just how much difference can a 32-bit bus make? Stay tuned: We'll be looking at EISA- and MCA-bus 33-MHz 486s in upcoming issues of *PC Magazine*.

INNER SPACE

Form-factor considerations come into play as well. If you're buying a 486 PC to use as a server, a tower design is probably a better choice than a standard desktop chassis. Sure, you can turn that desktop machine on its end and put it on the floor. But even with an accessory stand, it's still too easy to knock the unit over, with potentially catastrophic results for its hard disk and other delicate components. And you won't have the ease of access to slots and drive bays that a tower-design machine offers. You may not have as many slots and bays, either.

How many expansion slots, and how many drive bays, are enough for a network server? You'll probably want room for at least five or six drives: two hard disks (with one possibly mirrored to the other for continuous, real-time backup and an instant replacement when one disk

We had an interesting time wrestling with the issue of which companies were actually shipping true 33-MHz 486-based PCs.

goes down), one or two floppy disk drives (one 5.25-inch and one 3.5-inch), one CD-ROM drive, and one tape backup drive. The floppy disk drives, CD-ROM drive, and backup system you choose will almost certainly be half-height units. If you're sure you'll be using half-height hard disks, too, that means you need five or six half-height drive bays. That's stretching the limits of even the largest desktop-chassis machines.

Then again, you may need enough room for two full-height hard disks. While the physical size of hard disk drives is decreasing at the same time their storage capacity is increasing, the really big-capacity drives are still full-height devices. And that means you'll need eight half-height or four full-height bays, which simply can't be found in desktop PCs.

Of course, if you think you may later want to move on to "drive arrays," as offered by Compaq and Dell—stacks of hard disks run from a controller that can simultaneously read from or write to several disks—then you'll need even more space.

What about the number of expansion slots? Today's top-of-the-line PCs put many functions on the motherboard that once required slots and cards. VGA video, for example, may be found on the motherboard; parallel- and serial-port circuitry is almost certainly found there. But disk controllers, network cards, data modems,

fax modems, CD-ROM drive interface cards, backup interface cards, and more can quickly fill up those slots. Remember, too, that putting more network interface cards in the server is one good way of improving network throughput. All this means that long before the useful life of a 486 comes to an end, you may have filled up its slots and be yearning for more.

Six open slots are an absolute minimum for 486s destined for server duty. Eight slots is a far safer bet, and ten to twelve slots wouldn't be excessive.

Of course, if you're buying a 486 machine for use as a workstation, you probably won't need so many drive bays or expansion slots. Still, a power hardware platform attracts power applications, which in turn often require expansion beyond the original configuration.

FIRST MAY NOT BE BEST

As every new generation of PCs rushes to market, we see vendors trying to seize a marketing edge by being first with the new machines. Among this crop of 33-MHz 486s, we saw more evidence of hurried design and construction than we'd like—and more than we've seen with other new classes of PCs.

While we expect to see some last-minute jumper wires soldered onto motherboards to fix problems not yet ironed out of the board designs, a few of these machines had more than we would have liked. Two vendors had substituted 34-MHz crystals for 33-MHz parts; they claimed they were forced to do this because of a shortage of 33-MHz crystals. We insisted that those vendors replace their hopped-up machines with true 33-MHz units. A faster crystal may provide an apparent performance edge, but since Intel will not guarantee chips run faster than their rated speed, it's a risky bet. One vendor even used a 25-MHz 486 chip driven by a 33-MHz crystal; here, too, we insisted on a replacement.

TRUTH IN ADVERTISING

We also had an interesting time wrestling with the issue of which companies were actually shipping true 33-MHz 486s, as opposed to merely advertising them and taking orders for future delivery.

We placed anonymous calls to vendors and requested shipping dates. We also spoke with Intel about the availability of the 33-MHz 486 CPU in production quantities. We got some encouraging words—vendors say they're shipping units now,

and Intel says there shouldn't be a shortage of components—but we've heard both stories before.

We encourage buyers to insist on firm shipping dates when placing orders. As always, it's also a good idea to confirm the exact configuration of the machine that will be shipped to you, down to the make and model number of internal components such as hard disks. Shifting relationships with suppliers, fluctuations in OEM-level component pricing, and the constant revision and renaming of components means that vendors often make changes in their machines' internal configurations without noting those changes in their ads. These changes may affect pricing and shipping dates.

If you want to buy a machine configured exactly as these test machines were configured, you'd better nail down every detail with the salesperson taking your order. Never assume that they will know what you want.



INTERIOR CONFIGURATION KEY

CASE

Cases typically come in five sizes: full desktop (shown here), full-height small-footprint, half-height small-footprint, tower, and mini-tower.



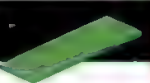
MOTHERBOARD

Motherboards come in a wide variety of sizes, including full size (shown here) and small-footprint size.



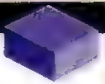
EXPANSION BOARD SLOTS

In these diagrams, all slots are represented by full-size boards.



POWER SUPPLY

Power supply options fall into four categories: large (shown here), medium, small, and long and narrow.



DRIVE BAY

Drive bays typically come in four different sizes: full-height (shown here), half-height, one-third-height, and 3.5-inch size.



BEYOND 33 MHz

Overall, these 33-MHz 486s offer a raw performance increase of about 33 percent over 33-MHz 386s and about 25 percent over 25-MHz 486s. Prices of 486/33s can be anywhere from about 10 percent to 30 percent higher than similarly configured 486/25s, and typically more than 50 percent higher than their 33-MHz 386 counterparts.

Even a casual glance at those numbers shows that buyers of 486 PCs are paying a premium that is out of proportion to the actual improvement in performance. But that's always been the case in the personal computer business: Early buyers of leading-edge machines are reaching for every available ounce of speed, and the cost of that last ounce is always high.

When we looked at 25-MHz 486s in September, we said that with 486 PCs coming to market at 25-, 33-, and 50-MHz speeds, the 50-MHz designs would probably be the most interesting machines and ultimately the big winners in the marketplace. That would echo our experience with the 386, which appeared in 16-, 25-, and 33-MHz speeds—with the 33-MHz machines now dominant.

Intel threw a wrench into the works with its announcement last fall that delivery of 50-MHz 486 chips would be delayed significantly. Previously, Intel had promised production quantities of 50-MHz parts by the end of 1990; now the forecast is for delivery "sometime in 1991."

Intel's problems with the faster 486 center on heat dissipation. The hefty heat sinks found on most 25-MHz and 33-MHz 486 PCs attest to the considerable heat generated by this powerful chip. Heat increases dramatically as speed increases; delivering reliable performance at high speeds is largely a matter of dissipating that heat before components within the chip start breaking down.

This delay in the general availability of 50-MHz 486s doesn't change our view that the 50-MHz machines are going to be the most interesting of the 486 PCs, but it does mean that these 33-MHz 486s will probably enjoy a longer reign at the top of the market than would otherwise have been the case.

Given the confusion over the relatively costly advantages of the 486, along with buyers' demonstrated reticence to jump into a 486 world, you can safely bet that it will be a long time before any 486-class

PC achieves the status of today's 386s. For most large buyers of PCs, and for most PC manufacturers, 1989 was the year the 386 really took over. If we include both DX and SX varieties, the 386 chip now has an overwhelming share of the PC market.

Some seers had foreseen a shift to 486 dominance during 1991. Given the slow start of the 486 and the delays in delivering 50-MHz chips, that now seems impossible; the earliest the pendulum might swing from 386 to 486 market dominance would be late 1992—and most observers think that's a highly optimistic projection.

Far from casting doubt on the value of 486s, this simply affirms that the standard Intel set with its 386 line (and remember, the 486 is really just an extension of that line) is going to be the enduring standard for desktop PCs well into the 1990s. These 33-MHz 486 PCs represent today's high-water mark within that standard.

ACMA COMPUTERS INC.

ACMA 486/33 Engineering Workstation

by Bruce Brown

Backed by better-than-average service and support policies and selling via mail order for a decent list price, ACMA Computers' 486/33 Engineering Workstation is a respectable machine that should serve engineers, network managers, and graphics users equally well.

Even in its \$5,895 basic configuration, the ACMA 486/33 is well stocked, including 4MB of RAM, a 128K processor RAM cache, an 18-millisecond 150MB NEC hard disk, both 1.2MB and 1.44MB TEAC floppy disk drives, an ACMA VGA adapter and Helms Engineering Impressions Super VGA monitor, and DOS 3.3 or 4.01. Boost the RAM to 8MB and substitute an 18-ms. 210MB Rodime IDE hard disk and the system lists for \$6,225. Rounding out the picture are a 101-key Maxi-Switch keyboard and one parallel and two serial ports and a game port.

Going those configurations one better, our \$7,195 tested system came with an Orchid ProDesigner II Super VGA board with 1MB of video RAM and a Seiko CM-1450C Super VGA monitor—a combination capable of producing noninterlaced video with a maximum resolution of 1,024

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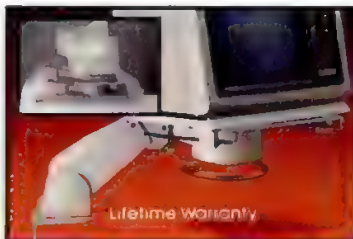
Executive Monitor Arm

Arm and monitor platform rotate 360°; 11" x 13" platform tilts 25°, holds up to 65 lbs. securely; retractable keyboard storage rack.

#MA-2 Retail \$139.95



Lifetime Warranty.



Lifetime Warranty.

Professional Monitor Arm

8-axis design provides infinite adjustable elevation and 360° rotation; 11" x 13" platform tilts 25°, holds up to 65 lbs. securely; retractable keyboard storage rack tilts 30° for more comfortable use. #MA-3 Retail \$239.95

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uld take laser far, this fast.

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Introducing the Epson® EPL-7500 laser printer. One of the first true Adobe® PostScript® laser printers designed around a lightning-fast RISC processor.

The result is *significantly* faster output.

It is also *significantly* better.

Thanks to true Adobe PostScript — not a clone — the EPL-7500 is able to produce razor-sharp text in 35 scalable fonts, plus equally impeccable graphics. Blacks are blacker and lines are finer, courtesy of the printer's unique MicroArt Printing technology.

The EPL-7500 handles paper as well as it handles text and graphics. A 250-sheet tray comes standard, a second is optional. Also standard are serial, parallel and AppleTalk® interfaces, allowing the printer to work smoothly in both PC and Macintosh® environ-

ments. For even greater versatility, HP® LaserJet® Series II emulation is included.

Of course, not everyone needs a PostScript printer. That's why the Epson laser line also includes

the new EPL-7000. Like the EPL-7500, it offers brilliant MicroArt Printing, superior paper handling and HP compatibility. Plus a host of other serious business features, all loaded into an extremely affordable package. Moreover, the EPL-7000 even allows upgradability to the EPL-7500's true PostScript and RISC processing.

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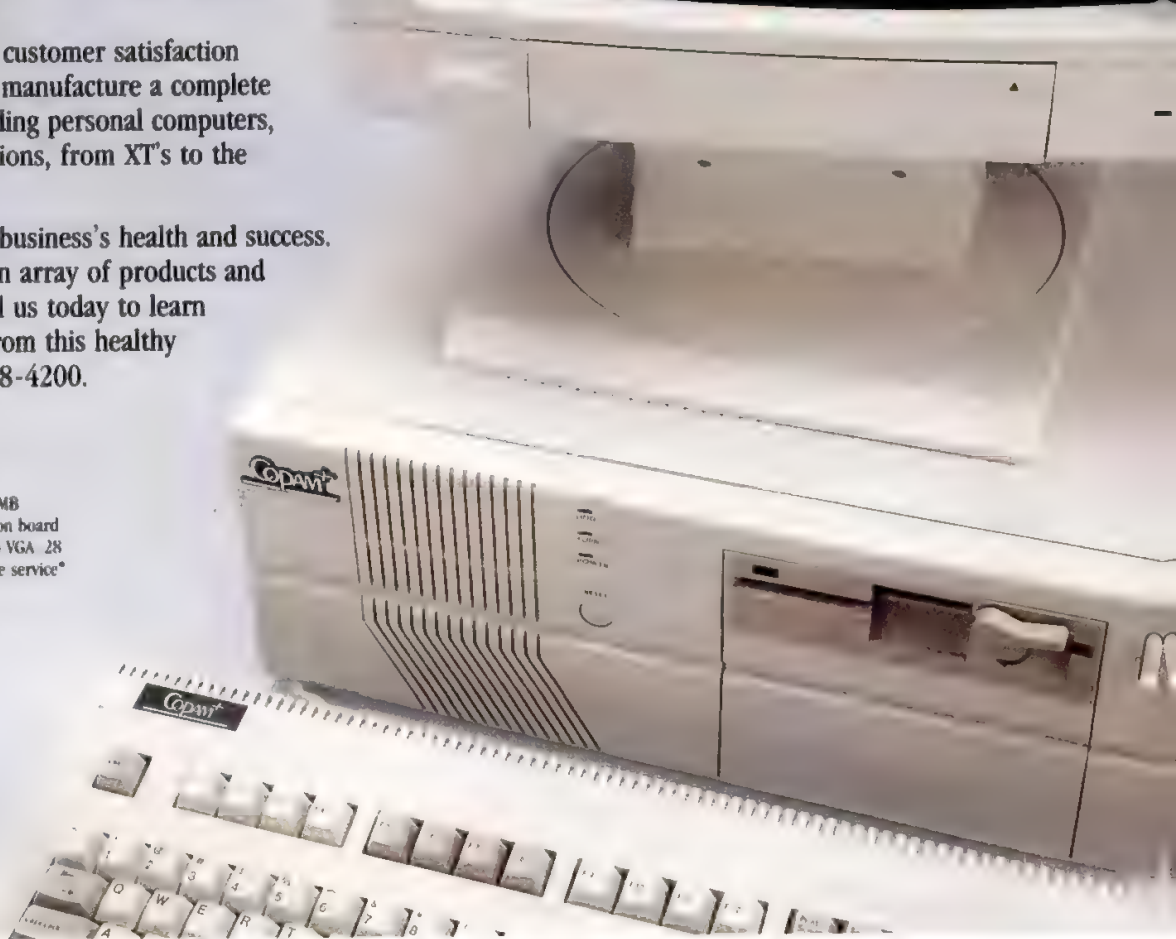
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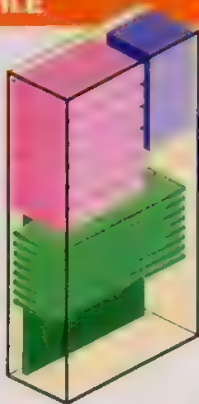
FACT FILE

ACMA 486/33 Engineering Workstation
ACMA Computers Inc., 117 Fourier Ave., Fremont, CA 94539; 800-456-1818, 415-623-1212.

List Price: With 4MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, 1MB 1,024-by-768 video adapter, Super VGA monitor, one parallel and two serial ports, game port, DOS 4.01, \$5,895; with 8MB RAM, 210MB hard disk, \$6,225; with Orchid ProDesigner II 1MB video adapter, Seiko 1450 1,024-by-768 noninterlaced monitor, *Microsoft Windows 3.0*, *Microsoft Mouse*, 450-watt power supply, \$7,195.

In Short: ACMA's tower-case 486/33 Engineering Workstation is a fine, solid buy. This computer has memory expansion up to 24MB, room for six drives, and good service and support policies, including on-site service from TRW and a 45-day money-back guarantee.

CIRCLE 408 ON READER SERVICE CARD



which fits into the machine's single 32-bit expansion slot, and fill it with up to 16MB more memory. ACMA's current price is \$90 per megabyte.

In addition to the 32-bit slot, which can also accept standard 8-bit cards, the AMI motherboard has one 8-bit and six 16-bit slots. With I/O, drive interface, and video cards installed, our test system was left with five slots free.

You can set the processor to run at one of several speeds (8, 12, 16, 20, 25, and 33 MHz) through software, and you can change the bus speed by replacing the socketed I/O bus crystal. The standard crystal runs the bus at between 7 and 9 MHz, but other crystals are available in case your peripherals support faster I/O. This adaptability may mean more in the future as faster interface cards become available.

The ACMA 486/33 Engineering Workstations's standard, nonupgradable 128K processor RAM cache uses discrete logic and comprises 25-ns. static-RAM DIP chips. System BIOS is always shadowed in RAM, but you can choose whether or not to shadow the video BIOS instructions. A socket on the motherboard accommodates a 33-MHz Weitek 4167 math coprocessor.

On PC Magazine Labs' benchmark tests, the ACMA 486/33 fared well overall, with performance that ranged from exceptionally fast to relatively slow. It tied with several other machines for first place on our Conventional Memory test, and earned the second-highest score (along with several others) on our 80486 Instruction Mix test. Its video performance was

by 768 pixels. Also included were *Microsoft Windows 3.0*, a serial *Microsoft Mouse*, and an upgraded 450-watt PC Power and Cooling power supply with five device connectors.

The ACMA 486/33's 25.5- by 7.5- by 17.5-inch tower case provides room for six half-height 5.25-inch drives; if you choose to attach the included system stand, the unit measures 9.5 inches wide at its base. In addition to the hard disk options already mentioned, ACMA offers 80MB and 105MB IDE drives and 338MB and 676MB ESDI drives as well as 60MB/120MB and 150MB internal tape backup units. On the front panel of the case are power, reset, and turbo switches, a turbo indicator, and an electronic keyboard lock. The unit does not have a mechanical case lock.

The ACMA 486/33 is one of several machines reviewed in this issue that uses the AMI Voyager motherboard, which allows the system to hold 24MB of 32-bit system RAM and which gets its smarts from a Chips and Technologies 486 chip set and an AMI BIOS. You can install 8MB of RAM on the motherboard using 1MB SIMMs; our evaluation unit came with 60-nanosecond modules. To bring the system RAM up to the maximum, you'll have to buy a \$225 memory card,

faster than average, but its hard disk scores were slower than almost all the other machines.

ACMA Computers stands behind this system with a warranty for one year on parts and two years labor. Also standard are on-site service by TRW and a 45-day money-back guarantee. Should you need technical assistance, you can call ACMA's toll-free technical support line. The computer ships with a Class A certification from the FCC.

In all, the ACMA 486/33 Engineering Workstation is a fairly priced system from a vendor with a solid reputation and above-average service and support policies. Whether it is used for engineering applications or as a file server or graphics platform, this computer is easy to recommend.

AMAX ENGINEERING CORP.

Amax PC/486 Power Station

by Bruce Brown

If you're in the market for a reasonably priced 33-MHz 486 machine that's sold through dealers, you need look no further than Amax Engineering Corp.'s PC/486 Power Station. This system sells at an attractive price and offers a decent amount of room for memory and drive expansion.

Equipped to meet our standard configuration for this review, the Amax PC/486 sells for just \$5,495 (and since the machine is sold by dealers, you can probably negotiate a better price than that). The configuration includes 8MB of RAM, a 128K processor RAM cache, an 18-millisecond 210MB Rodime IDE hard disk, a 1.2MB TEAC floppy disk drive, a Helms Engineering Impressions Super VGA video adapter and monitor, one parallel and two serial ports, a game port, a 101-key Maxi-Switch keyboard, DOS 4.01, and *Microsoft Windows 3.0*. Subtract 4MB of system memory, the hard disk, and the video system and you'll wind up with the machine in its \$3,900 basic configuration.

Our tested unit lists for \$7,795—a big jump in price from the basic and standard configurations, but also a big step up in components. That figure buys 8MB of RAM, the 128K cache, a 14.5-ms. 355MB Maxtor ESDI hard disk, a 1.2MB and a 1.44MB TEAC floppy disk drive, an Orchid ProDesigner II Super VGA board



ACMA 486 33, \$7,195

FACT FILE

Amax PC/486 Power Station

Amax Engineering Corp., 47315 Mission Falls Ct., Fremont, CA 94539; 800-888-2629, 800-888-5268 (in southern Calif.), 415-651-8886

List Price: With 4MB RAM, 1.2MB floppy disk drive, one parallel and two serial ports, game port, DOS 4.01, Microsoft Windows 3.0, \$3,900; with 8MB RAM, 128K RAM cache, 210MB hard disk, Super VGA display subsystem, \$5,495; with 355MB hard disk, 1.2MB and 1.44MB floppy disk drives, 1MB Super VGA video adapter, 20-inch 1,024-by-768 noninterlaced monitor, \$7,795.

In Short: The Amax PC/486 Power Station is aggressively priced, and it can hold six drives and up to 24MB RAM. It is sold through dealers only, and optional on-site service is available.

CIRCLE 409 ON READER SERVICE CARD

with 1MB of video RAM, and a 20-inch Seiko CM-2050 color monitor, which is a good size if you intend to run the noninterlaced video in its maximum resolution of 1,024 by 768 pixels.

The Amax PC/486 Power Station's 25.5- by 7.3- by 17.5-inch chassis can hold up to six half-height 5.25-inch drives in addition to a 250-watt Enhance power supply with four power connectors. When you attach the included base, the system unit is 9.5 inches wide at the bottom. The power, reset, and turbo switches, turbo indicator, and electronic keyboard lock are conveniently located on the front of the case.



Amax PC/486 Power Station, \$7,795

Like several other 33-MHz 486 machines reviewed here, the Amax PC/486 uses the popular AMI Voyager motherboard. Chips and Technologies provides the 486 chip set, and AMI supplies the BIOS, which supports both system and video BIOS shadowing; you can disable video BIOS shadowing in setup. You can set the Amax PC/486's processor to run at either 8 or 33 MHz; its bus speed is fixed at 8 MHz.

Also fixed is the Amax PC/486's standard 128K cache. Making use of discrete logic, the static-RAM cache in our evaluation unit used DIP chips rated at 25 ns.

The Amax PC/486's motherboard holds up to 8MB of fast page-mode system RAM, using 1MB SIMMs; 60-ns. SIMMs were installed in our tested system. You can install another 16MB of RAM by adding a \$186 memory expansion board, thus raising the total 32-bit memory to the system's 24MB maximum. Amax sells 8MB of RAM for \$594 and 4MB for \$297.

The add-in memory board takes up the Amax's single 32-bit expansion slot, which otherwise can hold a standard 8-bit board. Additionally, the motherboard has one 8-bit and six 16-bit slots. With an Adaptec integrated SCSI controller, an I/O board, and a video adapter installed, our evaluation unit had five available expansion slots. The motherboard also has a socket for a 33-MHz Weitek 4167 math coprocessor.

On our tests, the Amax PC/486 Power Station was an ordinary performer, with faster-than-average video times, slower-than-average hard disk times, and middle-of-the-road 80486 Instruction Mix and Conventional Memory times.

The Amax PC/486 bears an FCC Class A certification and comes with a one-year parts-and-labor warranty; service is provided by dealers, who are the machine's sole distributors. In addition, you can opt for an extra-charge on-site service contract with Memorex Telex Corp., and you can get technical assistance by calling Amax's toll-free support line Monday through Friday from 9:00 to 5:00 Pacific Standard Time.

The Amax PC/486 Power Station has proven name-brand parts, an attractive price, and the right level of performance for this class of machine. It's hard to see how you could go wrong by checking this one out.

ARCHE TECHNOLOGIES INC.

Arche Legacy ProFile 486-33

by Bruce Brown

If you disregard its high list price, the Arche Legacy ProFile 486-33 is in many ways an appealing machine, with excellent performance, lots of room for system memory, and space for a good number of drives. But if you consider that \$13,734 buys what many other vendors in this roundup offer for \$8,000 or less—8MB of RAM, a 256K processor RAM cache, a 16-millisecond 338MB Seagate hard disk, a Super VGA board and VGA color monitor, one parallel and two serial ports, a game port, a 101-key keyboard, and DOS 4.01—it's pretty hard to justify the extra money.

Without a hard disk and video system, Arche sells the base-priced Legacy ProFile for a princely \$9,455, with 4MB of RAM and DOS 3.3. Add a 180MB ESDI hard disk drive, and you'll pay five figures—\$11,210 to be exact.

Inside the Legacy ProFile's 23.8- by 6.5- by 18.8-inch tower chassis are two 3.5-inch drive bays, two half-height 5.25-inch bays, and two spaces for full-height 5.25-inch drives, which will also accommodate one half-height drive each. The power supply in the tested system was a 220-watt Arche unit with four device connectors; Arche says that new systems will use a 250-watt model. The power and reset switches and keyboard lock are on the front of the case. The system does not have a turbo switch or a mechanical case lock.



Arche Legacy ProFile 486-33, \$13,734

In Gothenburg, Sweden...

You'll find a bustling seaport city, thousands of bicycles, reserved yet friendly people and Gateway 2000 computers.

Anders Bjernfors, a computer dealer and programmer, bought a Gateway 2000 25 MHz 486™ system last April.



Anders Bjernfors, owner of Computer Link AB, and his Gateway 2000 25 MHz 486 computer.

"After many faxes and a lot of study," said Anders, "I selected Gateway 2000. I'm pleased with the machine. I received a very powerful, well-built computer for an astonishingly low price."

Anders was so impressed by his system and by the people at Gateway that he contacted the company about becoming a Gateway 2000 reseller for the Nordic countries of Sweden, Norway, Denmark and Finland. "I telephoned my salesman about a dealership," Anders remembered, "and he told me I'd have to visit the factory to make the arrangements. I was on the next plane out of Göteborg on my way to North Sioux City, South Dakota."

Today, Anders's company, Computer Link AB, sells and services Gateway 2000 products.

Although Gothenburg – or Göteborg in Swedish – is as far north as Siberia, warm ocean currents give the city a mild climate. Residents swim in the North Sea all summer long.



™86 is a trademark of Intel Corporation.





And in Worland, Wyoming...

You'll find yourself in the hub of the Big Horn Basin, surrounded by some of the most spectacular scenery in the western United States. You'll see sugar beet farms, petroleum wells and Gateway 2000 computers, too.

Bob Borst, owner and operator of Cloud



Bob Borst, owner and operator of Cloud Peak Pest Control, and his Gateway 2000 386SX.



Peak Pest Control in Worland, spent two and a half months researching his computer purchase. He chose a Gateway 2000 386SX.

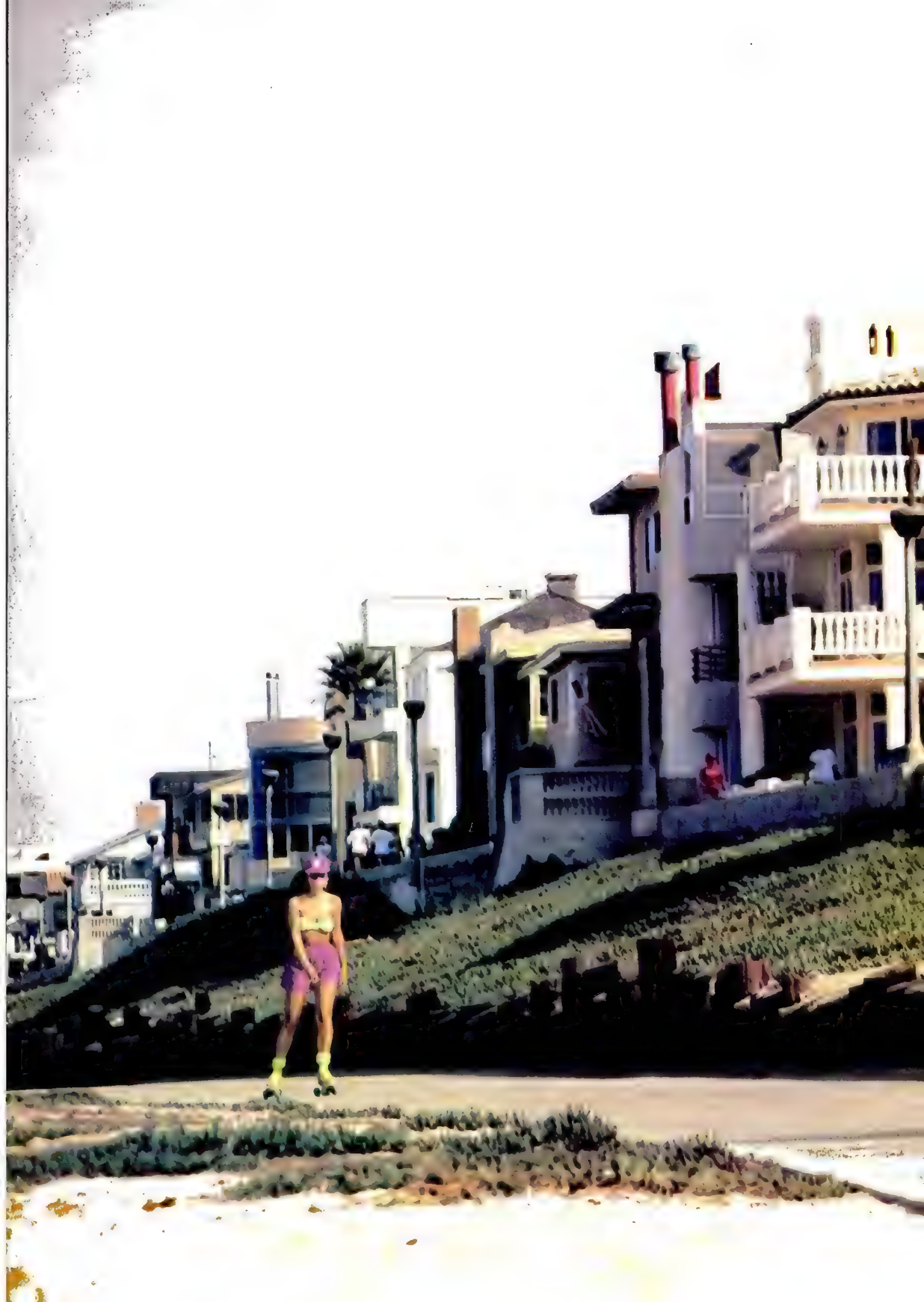
"My final decision was based on people, not hardware," said Bob. "The Gateway people make you feel like you're the most important person in the world. I didn't buy a computer - I bought Gateway."

Bob was equally impressed by Gateway's service people. "One time I got into a file and couldn't get out of it," Bob related. "Even though they're not responsible for software problems, I called Gateway and they talked me through it."

Bob said he'd like to work for Gateway 2000 - and he already has experience in sales. When Bob received his computer, he showed it to his friend Kip who decided to buy one too.

Worland is near Yellowstone, the country's oldest and most famous National Park. Yellowstone Lake is just one of a thousand awesome sights in this treasured preserve.





In Manhattan Beach, California...

You'll find refreshing ocean breezes, seaside skaters, more surfers and another indestructible Gateway 2000 computer.

After the firemen left Bob Baskerville's charred office building, the co-owner of MMB Development Corporation was reluctant to see



Bob Baskerville, MMB Development Corporation, and the Gateway 2000 33 MHz 386™ computer that survived the fire.

what was left of his computers. MMB is a software development company best known for TEAMate™, a UNIX™ bulletin board program. The computers, including Bob's Gateway 2000 33 MHz 386 system, were water-damaged and covered with "black gunk."

"My partner and I took each machine apart," recalled Bob, "washing the components and drying them with freon. One of the few systems to survive this risky procedure was the Gateway — and it's still purring along today as if nothing happened." MMB recovered from the June fire equally well. In October, Release 1.8 of TEAMate was shipped on schedule.

Bob said he lost all of his system manuals in the blaze. When he called Gateway 2000 and explained what happened, the company promptly sent new manuals free of charge.

The ocean-front, called The Strand, is a popular spot for Manhattan Beach skaters, bikers and joggers.



TEAMate™ is a trademark of MMB Development Corporation.
UNIX is a trademark of AT&T. 386 is trademark of Intel Corporation.



In Somerset, England...

A two-hour journey west from London, you'll find lush green meadows sprinkled with wild flowers, stone fences, red-jacketed hunters on horseback and Gateway 2000 computers.

This picturesque place is the home of Len Jones, Managing Director of Data Encryption



Len Jones, Data Encryption Systems Ltd., and his Gateway 2000 25 MHz 386 system.

Systems Ltd. and Gateway 2000 customer. Len operates his company, which provides software protection devices, from his 150-year-old country home located between Cannington and Bridgwater. He uses three Gateway computers in his business – a 25 MHz 386 and two 33 MHz 386 systems.

"I looked into three or four American computer companies before I decided to buy a Gateway 2000," Len commented. "When I compared features and prices, Gateway offered the best value. And," he continued, "I liked the selection of systems the company offered."

Len also talked about his initial reluctance to buy a mail order computer. "Europeans are not accustomed to buying through direct mail," he commented. "But I developed a good relationship with my Gateway sales representative and I feel quite comfortable doing business this way now. I've recommended Gateway to a number of people here in the UK."

The London Tower Bridge across the River Thames represents Victorian architecture and engineering at its best.





And in Socorro, New Mexico...

You'll find the New Mexico Institute of Mining and Technology, a small but rigorous school known for science and engineering programs, and Gateway 2000 computers.

Gordon Kane, Laboratory Associate in the Electrical Engineering Department, runs



Gordon Kane, New Mexico Tech Laboratory Associate, with his Gateway 2000 286 lab computers.

student laboratories with 15 Gateway 286 computers and a growing number of Gateway 386 computers.

"We decided to use a modern, PC-based approach for teaching digital and microprocessor electronics," said Gordon. "The quality of Gateway's equipment and their low prices led us to purchase the Gateway computers. This, and the quality of their service, has caused us to continue purchasing computers from Gateway."

New Mexico Tech also uses a Gateway 386 cache computer in research to develop a real-time processor and display system for a sophisticated dual-polarization radar.

"The radar and computer will be used at Kennedy Space Center next summer," said Gordon, "as part of a large program of thunderstorm studies being conducted there by NASA and the Air Force."

In the nearby Magdalena Mountains, NMT uses a Gateway 2000 386 system to support lightning research.



People the World Over

Everywhere you look these days you'll find Gateway 2000 computers. That's because people everywhere know a good value when they see one. In all 50 states and in over 70 foreign countries, thousands of people are comparing price, quality and service – and choosing

with pride by one of Gateway's Midwest technicians. As the reviews indicate, the quality of a Gateway 2000 system is comparable to the best PC's on the market.

"One of the few systems to survive (the fire) was the Gateway – and it's still purring along as if nothing happened."

Bob Baskerville

"...the company is committed to improving its product line."

Gordon Kane



*Computer Shopper
Explores, Award Customer
Survey's 22,414,386 used
to select 150 countries
Best Buy 1990*

Gateway 2000. Compare for yourself.

Price

Examine the last page of this ad, where you'll find a concise listing of Gateway 2000's product line, and compare Gateway's features and prices with any other computer manufacturer. Many competitors try to trick you with low prices on stripped-down systems. Others copy Gateway's features and prices but don't tell you they're using fishy components and building their systems in the back of their brother-in-law's bait shop. When you've had enough of the confusion, call Gateway for some straight talk from a knowledgeable sales person. In a direct comparison, Gateway has the best prices.

Quality

Don't let Gateway's low prices deceive you about quality. Only the highest quality components go into a Gateway 2000 computer. Each system is custom-built

Service

Of all the factors to consider when selecting a computer, service is perhaps the most important and the most difficult to judge. When customers talk about Gateway 2000, they invariably mention service.

"The Gateway people make you feel like you're the most important person in the world. I didn't

buy a computer

— I bought

Gateway."

Bob Borst

"Gateway's

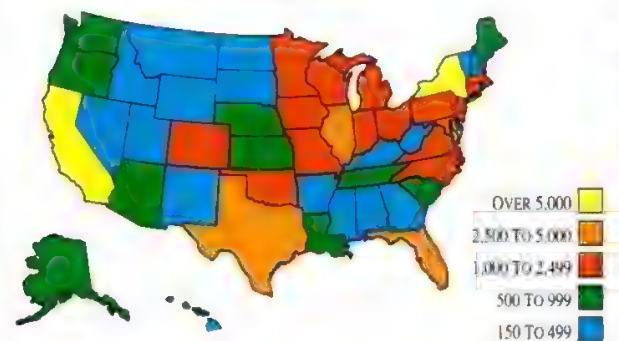
technical

support is

superior."

Gordon Kane

Gateway 2000 New Customers From October 1989 through July 1990



The results of PC Magazine's survey about service and reliability confirm what these Gateway 2000 customers are saying:

Choose Gateway 2000!

"Gateway shared top billing with such heavyweights as Compaq, IBM, and HP for those who would buy their products again... Overall,

Gateway's high marks bode well for the company's future, as does its



commitment to customer service."

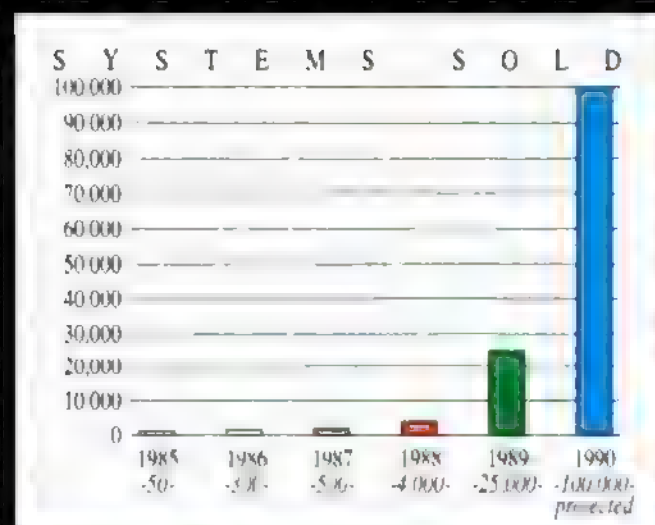
PC Magazine

September 25, 1990

Success

The combination of price, quality and service makes Gateway 2000 the best value in the industry. But value alone doesn't explain how a little company in the Midwest, just celebrating its fifth anniversary, managed to outdistance hundreds of other companies, selling more systems through the direct market channel than any other PC manufacturer in the country.

"It was the cows," laughed Ted Waitt, Gateway 2000 President and CEO. "Of course." Computer magazine readers will remember that the company's



Gateway 2000 sells more computers through the direct market channel than any other PC manufacturer in the country.

run that ad anymore," continued Ted, grinning.

"because we built a new plant 14 miles down the road in South Dakota. But the cows really worked for us.

"In the computer industry, longevity should be measured in dog years."

They made the phones ring. From then on, though, we built our business on value – good prices on quality systems with old-fashioned, personal service."

Ted mentioned another reason for Gateway's success.

"We take a long-term approach to customer service," he said. "When you buy a computer from Gateway 2000, you become part of our family and we're going to be there for you as long as you own that machine."

As Ted talked about the company's fifth anniversary, he laughed again. "In the computer industry, longevity should be measured in dog years," he chuckled, "because everything's moving so fast. That makes Gateway 35 years old! But seriously, we've come a long way in five years. And I owe it all to the great people at Gateway and to our customers."

Dial the Phone

When you add it all up, you'll understand why people the world over choose Gateway 2000. So pick up the phone and dial. Whether you're from Oklahoma or Portugal, North Carolina or Australia, you've got a friend in the business at Gateway 2000.



Gateway 2000 will be there for you 'til the cows come home.



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GATEWAY 2000 SYSTEMS

12MHZ 286VGA

- 80286-12 Processor
- 1 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01



\$1495.00

GATEWAY 386SX

- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0



\$1895.00

25MHZ 386VGA

- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 1 MB
- 14" 1024 x 768 Color Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

\$2395.00

25MHZ 386CACHE

- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16 Bit VGA with 1 MB
- 14" 1024 x 768 Color Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0



\$2695.00

33MHZ 386VGA

- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16 Bit VGA with 1 MB
- 14" 1024 x 768 Color Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0



\$3195.00

25MHZ 486VGA

- 64K Cache RAM
- 8 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16 Bit VGA with 1 MB
- 14" 1024 x 768 Color Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

\$3995.00

BEST BUY

- Same features as our 33 MHz 386 VGA system except this machine has an 80 MB 17ms IDE Drive instead of the 200 MB 15ms IDE Drive.

\$2795.00

STANDARD FEATURES AND SERVICES

- Microsoft® WINDOWS™ and Mouse with all 386 and 486 systems
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- One-year warranty on parts and labor
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- Toll-free technical support for the life of the machine
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- Free overnight shipment of replacement parts
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NEW SALES HOURS 7AM - 10PM CST

Due to the volatility of the DRAM market, all prices are subject to change



8 0 0 - 5 2 3 - 2 0 0 0

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2024

The Arche-designed motherboard uses a proprietary version of the AMI BIOS and Arche's own 486 chip set. You can set the processor to run at 8 or 33.3 MHz, and the bus runs at 8 or 11 MHz. The motherboard's 256K 20-nanosecond static-RAM cache uses flagged-register copy-back caching to support cache coherency. System BIOS is always shadowed, and you can shadow the video BIOS as well. The motherboard also has a socket for a 33-MHz Weitek 4167 math coprocessor.

All system memory for the Legacy ProFile sits on the motherboard; in our evaluation unit, RAM took the form of eight 80-ns. 1MB SIMMs. Arche sells 1MB, 2MB, 4MB, and 8MB SIMMs, allowing you to install up to 64MB of 32-bit RAM on the motherboard.

The Legacy ProFile has eight expansion slots—two of them 8-bit and the rest 16-bit. Our tested unit had five free slots after a video adapter, an I/O card, and an UltraStor integrated ESDI controller with a 32K buffer were installed.

The Legacy ProFile performed exceptionally well on PC Magazine Labs' benchmark tests, with some of the fastest video and hard disk speeds as well as considerably faster-than-average memory and processor speeds.

Arche Technologies sells the Legacy ProFile through dealers only. The machine has an FCC Class B rating and is covered by a generous two-year parts-and-labor warranty; on-site service from

TRW is provided free for the first 30 days you own the system. You can purchase an on-site service contract with TRW to cover your system for the full two-year warranty period for \$149, a reasonably good price.

Excellent performance times and plenty of room for memory and storage devices are the outstanding features of the Arche Legacy ProFile 486-33. But its high list price means that even with a typical dealer discount of about 30 percent, you really have to need what the Arche system offers.

BITWISE DESIGNS INC.

Bitwise Model 433

by M. David Stone

Priced at a dear \$10,555 for *PC Magazine's* standard test configuration, Bitwise Designs' minitower Model 433 is notable for the flexibility of its drive bay arrangement. But in most other ways—including performance and room for expansion—the Bitwise Model 433 is a decidedly average 33-MHz 486-based machine.

In our standard configuration, the Bitwise Model 433 includes 8MB of RAM, a 200MB Conner IDE hard disk, a 1.2MB or 1.44MB TEAC floppy disk drive, a Trident Super VGA card with 512K of video RAM, a CTX auto-sync monitor offering interlaced and noninterlaced resolution of up to 1,024 by 768, a 101-key Key Tronic keyboard, and DOS 3.3 or 4.01. Also included is a one-year parts-and-labor warranty, complete with phone service and cross-shipping of parts. In its \$9,395 basic configuration, the Model 433 features 4MB of RAM, the same disk setup and keyboard, and a Hercules video adapter and 12-inch amber monitor.

Our review unit came with both 1.2MB and 1.44MB floppy disk drives and 1MB of RAM on the video card, yielding a system price of \$10,809. It also had a 15-millisecond Maxtor 200MB SCSI drive rather than a 16-ms. Conner drive. According to Bitwise, the two drives are equivalent in performance. Whatever the Maxtor drive gains with its slightly faster access time, it loses by having a smaller buffer—32K instead of the Conner drive's 64K.

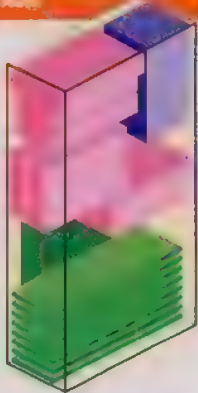
The Model 433's minitower chassis

measures 18.5 by 6.5 by 15.8 inches. On the front panel are power, reset, and turbo switches as well as a turbo indicator and keyboard lock.

Inside, you'll find room for more drives than you might expect, split between two sets of bays. The first set is a stack of three half-height 5.25-inch bays; only one of these was filled in our evaluation unit. The second set of bays allows one of three combinations: two half-height 5.25-inch drives, two 1-inch-thick 3.5-inch drives plus one standard-size 3.5-inch hard disk, or one 1-inch-thick drive plus two standard-size 3.5-inch hard disks. As tested, the system had two half-height 5.25-inch bays and one 3.5-inch bay open, leaving a substantial if not ideal amount of room for additional drives.

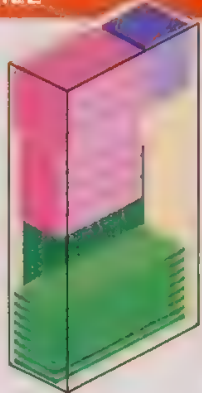
The key components of the Model 433's AIR motherboard conform to well-known standards: an AMI BIOS, a socket for a 33-MHz Weitek 4167 math coprocessor, and a chip set consisting of one Chips and Technologies chip and discrete logic. You can set the processor to run at 6, 16, or 33 MHz; the bus runs at a safe 8 MHz. The AMI BIOS supports system and video BIOS shadowing, both of which can be disabled in setup.

All RAM goes on a card that fits in the Model 433's single 32-bit expansion slot. Sixteen SIMM sockets allow a system maximum of 16MB. As tested, eight sock-



Arche Legacy ProFile 486-33
Arche Technologies Inc., 48881 Kato Rd., Fremont, CA 94539; 800-422-4674, 415-623-8100.
List Price: With 4MB RAM, 1.2MB floppy disk drive, one parallel and two serial ports, DOS 3.3, \$9,455; with 8MB RAM, 256K RAM cache, 338MB hard disk, Super VGA video adapter, VGA color monitor, DOS 4.01, tower case, \$13,734.
In Short: Though relatively expensive, the Arche Legacy ProFile 486-33 is a fast machine with room for lots of drives and a whopping 64MB RAM. It comes with a two-year warranty, and on-site service is standard for the first 30 days.

CIRCLE 410 ON READER SERVICE CARD



Bitwise Model 433
Bitwise Designs Inc., 701 River St., Troy, NY 12180; 800-367-5906, 518-274-0755.
List Price: With 4MB RAM, 200MB hard disk, 1.2MB or 1.44MB floppy disk drive, Hercules-compatible monochrome display subsystem, two parallel and two serial ports, game port, \$9,395; with 8MB RAM, Super VGA color display subsystem, DOS 3.3 or 4.01, \$10,555; with 200MB hard disk, 1.2MB and 1.44MB floppy disk drives, 1MB Super VGA video adapter, \$10,809.
In Short: The Bitwise Model 433 offers a minitower case, a flexible drive bay arrangement, and performance levels that are typical for a 33-MHz 386 computer. Yet the high price is hard to justify, since you can find comparable performance at roughly half the price.

CIRCLE 411 ON READER SERVICE CARD



Bitwise Model 433, \$10,809

ets were filled with 70-nanosecond SIMMs, yielding 8MB RAM.

In addition to the 32-bit memory slot, the AIR motherboard has five 16-bit and

two 8-bit slots. Three of these were filled on the tested unit, with the Super VGA card, an Adaptec floppy/hard disk controller, and an I/O card.

The only cache on the motherboard is the 8K in the 486 chip itself. But on PC Magazine Labs' processor and memory benchmark tests, the spread between the best and worst computers' performance was small enough to be inconsequential, indicating that additional cache doesn't make much difference—at least when you are using DOS.

SLIPPED DISK

More of a problem was the Model 433's disk performance. In our tests, its disk speeds generally were slower than those of the Bitwise Model 333C, a 33-MHz 386 machine that we reviewed last year

("386/33s: Mainstream Muscle," *PC Magazine*, December 25, 1990). In fact, disk performance for the Model 433 fell to the bottom among all the 486 machines we tested, partly because the system used a SCSI drive. In general, SCSI drives are relatively slow because of the overhead involved in translating physical addresses to the logical ones the SCSI controllers use. However, the Model 433 did turn in a stellar performance on the video tests we put it through, tying for first place in all three cases.

All told, the Bitwise Model 433 is hard to recommend—not that anything is wrong with the system, but it's easy to find equal or better performance in this roundup for far less money. If Bitwise lowers its prices substantially, you might well consider the Class A-certified Model 433. But at this point, nothing justifies the machine's lofty list price of \$10,555.

PROCESSOR RAM CACHE: Hype or Help?

The 8K of RAM cache on Intel's 80486 chip may not be quite enough to optimize your 486/33's performance, but in the end, only your pocket may know the difference.

by Bill O'Brien

Bigger is always better, and more is certainly better than less. At least, that's what most product vendors would have you believe. But when the product is an 80386 or 80486 computer and the topic is cached RAM, that philosophy is likely to be wrong. The effectiveness of a RAM cache in your 486-based computer depends greatly on how effectively the CPU and the RAM work together, and this is largely a function of their individual speeds.

Your CPU operates at a designated speed that is measured in millions of cycles per second. Currently, the 486's highest operating speed is 33 million cycles per second, or 33 MHz.

RAM speed, on the other hand, is rated by its access time—the time it

takes either to store or to release its contents—and that speed is measured in billionths of seconds, or nanoseconds.

THE SYNCHRONIZATION BLUES

Your CPU and your PC's memory work at different speeds. Getting them to communicate on an equal footing isn't difficult. But limitations in the hardware make finding the best combination of speeds more complex.

The inverse of the CPU's speed defines the relationship. So if 33 million cycles occur in 1 second, each cycle takes 30.3 nanoseconds. For the sake of convenience, let's round it off to 30 ns.

Typical access times for system DRAM (dynamic random access memory) found with processors having a 30-ns. cycle time are between 60 ns. and 80 ns., making DRAM less than half as fast as the CPU. Even the fastest DRAM memory devices currently used require the processor to wait through two of its own cycles before memory can complete one of its own. The time delay for each of these cycles is called a *wait state*. Further mechanical constraints hinder memory access speed. For example, the access rating for DRAM doesn't take into account its refresh and recharge times.

There are no tried and true formulas

for deciphering the exact time needed to refresh and recharge memory, but the added overhead can raise the true access time by 50 to 100 percent. At best, a 30-ns. processor must actually wait through three of its own cycles—or three wait states—before a memory device can complete one cycle. Compare that with the ancient IBM PC-XT running at 4.77 MHz (210 ns.) and you can better understand why 100- to 150-ns. DRAM chips worked well in 1981, but ten years later 60- to 80-ns. memory is in dire need of assistance.

The simple answer would be to use faster DRAMs. For a 30-ns. processor, 15- to 20-ns. chips would work well, if you could find them. But so far there are no chips that fast.

CASH AND COMPROMISE

An alternate solution makes use of SRAM (static random access memory), which doesn't need to be refreshed. Without that extra refresh overhead, SRAM chips can run as fast as 15 ns. A 30-ns. processor could easily get by with the 20- to 25-ns. SRAM chips currently available. When CompuAdd introduced its 333T, for instance, the vendor filled the first 640K of memory with fast SRAM chips. In testing this machine ("386/33s: Mainstream Muscle," *PC*

**BLACKSHIP
COMPUTER SYSTEMS INC.**
Blackship 486/33i

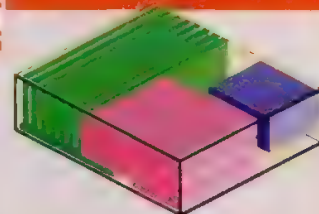
by Bruce Brown

When you're considering whether to purchase a mail-order system, factors such as service and support are as important as reasonable price and good performance. In the case of Blackship Computer Systems' Blackship 486/33i, performance and expansion capacity are only average, and the company's service and support policies fall a bit short of what the biggest mail-order houses offer, so that the machine has no compelling attraction.

Outfitted to conform to our standard configuration for this roundup, the tested unit sells for \$6,827 and features 8MB of RAM, a 64K processor RAM cache, a 15-millisecond 202MB Maxtor ESDI hard

disk, a 1.2MB TEAC floppy disk drive, an Orchid ProDesigner II Super VGA board with 512K of video RAM, a CTX Multi-Scan Super VGA monitor, one parallel and two serial ports, a game port, a 101-key Key Tronic keyboard, and DOS 4.01. Reduce the system RAM by 4MB and take away the hard disk and DOS and you'll have a bare-bones system that costs \$5,255.

The Blackship 486/33i uses an Atronic International motherboard with discrete logic and an AMI BIOS. The processor operates at either 8 or 33.3 MHz, and the bus at 8 MHz. The 64K RAM cache uses 25-nanosecond static-RAM DIP chips, again with cache controller circuitry built into the motherboard. The system lets you enable or disable video and system BIOS shadowing. The moth-


FACT FILE


**Black-
ship
486/
33i**
Black-
ship
Comput-

er Systems Inc., 4031 Clipper Ct., Fremont, CA 94538; 800-877-6249, 415-770-9300
List Price: With 4MB RAM, 1.2MB floppy disk drive, Super VGA color display subsystem, one parallel and two serial ports, game port, \$5,255; with 8MB RAM, 64K RAM cache, 202MB hard disk, DOS 4.01, \$6,827.
In Short: The Blackship 486/33i can hold but five drives in its desktop case, yet its performance is fine. Still, the somewhat high price (for a mail-order machine) and the lack of standard on-site support are causes for hesitation, since there's nothing particularly outstanding about the system.

CIRCLE 412 ON READER SERVICE CARD

Magazine, December 25, 1990), PC Magazine Labs saw a marked performance gain over other 386/33s using standard DRAMs for conventional memory. Unfortunately, these chips have proved too costly for most vendors to use exclusively.

A more common solution is a compromise that combines the less expensive DRAMs with the speedier SRAMs. It's called a RAM cache. A small number of SRAMs (currently anywhere from 8K to 256K) buffer the interaction of the processor and DRAM memory.

Recent benchmark test results for 25-MHz 386 computers ("386/33s: At the Peak of Their Careers," *PC Magazine*, January 15, 1991) clearly divide the group into two performance categories: those computers with a RAM cache and those without one. The noncaching machines proved substantially slower. Apparently, the crucial question is not "To cache or not to cache" but just how much cached RAM is necessary to improve processor and memory performance substantively?

NO SIZE FITS ALL

The 80486 is a case in point. Intel designed this chip to include an 8K internal cache, called its *primary cache*. But Intel now acknowledges that 8K has proved

less than optimal. Sometime around the first quarter of 1991, Intel expects to release its TurboCache chip, which contains an external cache controller and—you guessed it—more cached RAM. In fact, the chip has been designed so that four of them can be linked together for a maximum of 256K of external cache (called *secondary cache*). Computer vendors are already doing as much with their own secondary caching systems in 486 machines. And there's also the CompuAdd 333T. But that still doesn't answer the basic question: How much cached RAM is correct?

AN EDUCATED GUESS

To make a best guess (and that's the most you can do), you need to make some basic assumptions about how programs run. The one outstanding assumption is that programs are linear; that is, any program operates by executing one instruction after another until it comes to the end. If you're using the primary cache in a 486, you're gambling that all programs you run will fill the cache in 8K segments.

If that happened, only the fast SRAMs would be used to find the program instructions. Each time the processor hit on the cache it would find what it needed, producing a 100 percent hit rate. But

that's a big "if." Statistically, the actual hit rate runs somewhere between 83 and 86 percent in an 8K cache. But even those numbers have shifted in the last few years, with the same rating (plus or minus a few points) ascribed to everything up to a cache of roughly 64K. The only certainty is that 640K of SRAM is the only amount capable of producing a 100 percent hit rate in a DOS environment—and even then, it won't happen all the time. Other devices' demands on the memory, such as direct memory access (DMA) calls, can disturb the statistical reliability of the theoretical hit rate.

Many other factors, such as video speed, disk transfer rate, and even disk data format, can also detract from optimum processor operation.

Naturally, that leaves you with no sure way to make an informed choice about how much cached RAM to order with your computer. The only theorem you can apply states that the larger your cache, the greater the likelihood that the processor will find what it wants in the cache. But it's difficult to determine how much cached RAM is enough, and how much is overkill. Unfortunately, the only proven corollary to the theorem is: The larger your cache, the less cash you're likely to have left. ■

erboard also houses a socket for a 33-MHz Weitek 4167 math coprocessor.

In our tested unit, the 8MB of motherboard RAM took the form of 80-ns. 1MB



Blackship 486/33i, \$6,827

SIMMs. If you want to go beyond 8MB to, say, 16MB (the system's limit), you have to decide whether to use the RAM cache, since in the current design a single 32-bit slot can accommodate either a processor RAM cache board or a memory expansion card. This either/or design is counterproductive and not recommended, unless you know for sure that you won't ever want more than 8MB of RAM.

The Blackship's expansion slot setup is somewhat unusual in that the 32-bit slot, which uses half-length cards for either the cache or memory expansion, leaves room for a half-length 16-bit card as well. Used in that fashion the machine actually has nine slots: one 32-bit, six 16-bit, and two 8-bit. In our tested unit, four slots were taken up by a cache board, a video adapter, an I/O board, and a Western Digital integrated ESDI disk controller with a 32K buffer.

The Blackship's 6.5- by 21- by 16.8-inch case is the familiar full-sized AT desktop style, with room for five half-height 5.25-inch drives, three of which can use removable media. The power switch is on the right side of the chassis, and the reset and turbo buttons and combination keyboard/case lock are on the front. The machine is powered by a 220-watt DVE power supply, which has four device connectors.

Almost across the board, the Blackship 486/33i was an average performer. The one exception was the machine's video times, which were slower than average.

If the machine's performance is ordinary, the vendor's money-back guarantee

COVER STORY 33-MHz 486 PCs

is a bit unusual. For the first seven days that you own your system, it is covered by an unconditional money-back guarantee. After that, Blackship offers a conditional money-back guarantee for 30 days, the condition for return being that the machine was not capable of meeting the need for which you purchased it.

Blackship's one-year warranty covers parts and labor. The manufacturer provides service via a toll-free technical support line and has a procedure for cross-shipping defective parts. In addition, you can opt for on-site service from GE. The unit has an FCC Class B rating.

Given the Blackship 486/33i's memory expansion/cache board tradeoff, the company's slightly subpar return policies, and the machine's marginally competitive price, it's hard to make a strong argument for purchasing this system. Although Blackship's entry is a decent performer, other systems offer better expansion possibilities, are backed by better money-back guarantees, and sell for less money.

BLUE STAR MARKETING INC.

Blue Star 486/33

by Bruce Brown

It may sound jaded to describe a 33-MHz 486-class machine as plain or average, but



Blue
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486/33
Blue
Star

Marketing Inc., 2312 Central Ave. NE, Minneapolis, MN 55418; 800-950-8884 (sales), 800-950-8894 (tech), 612-788-1404.

List Price: With 1MB RAM, 128K RAM cache, 1.2MB floppy disk drive, monochrome display subsystem, one parallel and two serial ports, game port, shareware software, \$4,239; with 8MB RAM, 208MB hard disk, 1.2MB floppy disk drive, 1MB Super VGA display subsystem, DOS 4.01, *Microsoft Windows 3.0*, Logitech Mouse, \$6,714; with 1.2MB and 1.44MB floppy disk drives, \$6,799.

In Short: The Blue Star 486/33 comes with on-site service and a 30-day money-back guarantee. The standard-configuration price is a bit high for a mail-order PC, especially as its desktop case holds just five drives.

CIRCLE 413 ON READER SERVICE CARD

those adjectives are appropriate for the Blue Star 486/33. This desktop PC sells at a price that begs to be lowered a bit, but it offers a fine amount of expansion room



Blue Star 486/33, \$6,714

for its type of case and is backed by service and support policies that are in line with those of the best mail-order houses.

Our \$6,799 evaluation unit came with 8MB of RAM, a 128K processor RAM cache, a 15-millisecond 208MB Seagate IDE hard disk, one 1.2MB and one 1.44MB Toshiba floppy disk drive, a SpeedStar Super VGA video adaptor with 1MB of video RAM, a 13-inch Sony CPD-1304 Super VGA monitor (one of the reasons for the system's high price), one parallel and two serial ports, a game port, a 101-key Nan Tan keyboard, DOS 4.01, *Microsoft Windows 3.0*, and a Logitech serial mouse. With one floppy disk drive, the system costs \$6,714. In its \$4,239 base configuration, the system includes 1MB of RAM, a 128K RAM cache, a 1.2MB floppy disk drive, a Hercules adapter and monochrome monitor, a 101-key keyboard, and the same number of ports.

On the right side of the Blue Star 486/33's 6.5- by 21.3- by 16.8-inch case is the power switch, and on the front are the reset and turbo buttons and the electronic keyboard lock. The chassis can accommodate five half-height 5.25-inch drives, three of them using removable storage media.

The Blue Star 486/33 uses its own motherboard, which is based on discrete logic, and an AMI BIOS. It supports video and system BIOS shadowing; you can disable either one through the CMOS setup program. The processor runs at either 8 or 33 MHz, and the bus at 8 MHz. The Blue Star 486/33's 128K on-board external processor RAM cache is nonexpandable

A Winner.

We didn't say it.
PC Magazine did.



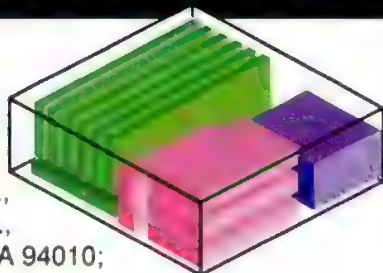
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EDITORS' CHOICE

Tangent

386SX/20

Tangent
Computer, Inc.,
303 Beach Rd.,
Burlingame, CA 94010;
(800)223-6677,
(415) 342-9388.



List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, VGA monitor, \$1,644; with 2MB RAM, 60MB hard disk, DOS 4.01, \$2,278; with 105MB hard disk, \$2,384.

In Short: An excellent contender with above-average electronics and hard-working peripherals, the Tangent 386SX/20 adds an FCC Class B certification to the pile to make it an extremely attractive computer for either home or office.

"The 20 MHz 80386SX is the new entry-level business system of choice, starting right now."

PC Magazine

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November 27, 1990
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Bill O'Brien, PC Magazine, 11/27/90

Thanks Bill. We couldn't have said it better.

Order now, Toll Free:

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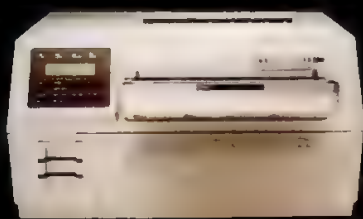
TANGENT
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197 Airport Blvd. Burlingame, CA 94010
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CIRCLE 391 ON READER SERVICE CARD

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The OL820: W/200 sheet 2nd paper tray



The OL840: W/200 sheet 2nd paper tray



The OL800: W/multi-user port (3 add'l users)*



The OL820: W/multi-user port (3 add'l users)*



The OL840: AppleTalk Network Ready

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and uses 35-nanosecond static-RAM DIP chips. The PC's motherboard is host to a socket for a 33-MHz Weitek 4167 math coprocessor.

Sixteen sockets on the motherboard (where all system memory resides) allow you to expand RAM to 16MB. The 1MB SIMMs that made up the 8MB of system memory in our tested unit were rated at 60 nanoseconds.

The motherboard provides eight expansion slots, all of them capable of holding either 8-bit or 16-bit interface cards. In our tested machine, three slots were occupied by video, drive interface, and I/O boards.

Compared with the rest of the machines we tested, the Blue Star 486/33's performance was average on the processor, memory, and disk benchmark tests, but that should still be considered quite fast. Better still was the performance of the unit's Tseng Labs chip set-based SpeedStar video card, which yielded some of the fastest times of the group.

Although Blue Star sells the 486/33 mainly through mail order, the company does have its own store and also makes the machine available to a few dealers in the Minneapolis area. All systems come with a one-year parts-and-labor warranty; on-site service by TRW is included. Blue Star also offers a 30-day money-back guarantee and a 24-hour toll-free technical support line, open 365 days a year. The system is rated Class A by the FCC.

Blue Star's excellent service and support policies are a big plus for the 486/33. Its list price could stand a reduction, but it isn't out of line for this solid desktop speedster.

BOSS TECHNOLOGY CORP.

Boss 486 Model 4633

by Edward Mendelson

You probably aren't in the market for a 33-MHz 486 machine because you like to play it safe, but if you are, Boss Technology Corp.'s Boss 486 Model 4633 may be the computer to buy. Boss asks \$7,995 (normally discounted by dealers) for *PC Magazine's* standard configuration—as we tested the machine—with 8MB of RAM, a 200MB SCSI half-height hard disk, a 1.2MB floppy disk drive, a Cardinal Super VGA video adapter and CTX Triscan Super VGA monitor, one parallel and two serial ports, a Honeywell key-

COVER STORY

33-MHz 486 PCs

FACT FILE

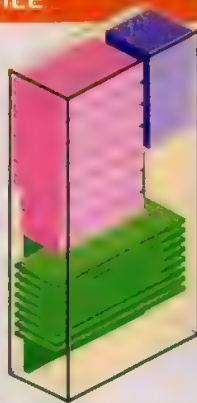
Boss 486

Model 4633

Boss Technology Corp., 6050 McDonough Dr., Norcross, GA 30093; 800-628-1787, 404-368-2077.

List Price: With 4MB RAM, 128K RAM cache, 40MB hard disk, 1.2MB floppy disk drive, VGA color display subsystem, one parallel and two serial ports, game port, \$5,995; with 8MB RAM, 200MB hard disk, Cardinal Super VGA video adapter, CTX Triscan Super VGA monitor, DOS 4.01, tower case, \$7,995.

In Short: This dealer-distributed tower machine offers exceptionally high-quality components at a reasonable price. You probably won't ever need the two-year warranty.



CIRCLE 414 ON READER SERVICE CARD

board, and DOS 4.01. Add a 1.44MB floppy disk drive for another \$100 and you still have three half-height drive bays and one 3.5-inch drive bay available for expansion in the sturdy tower case.

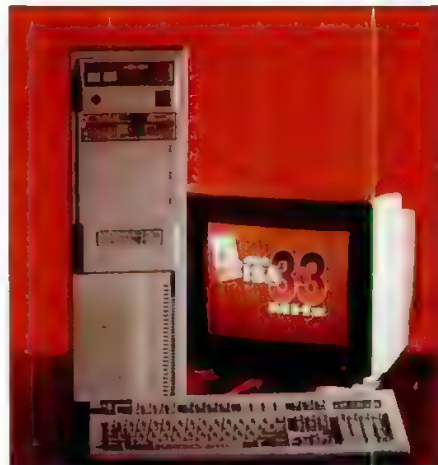
When you add in the cost of the 387 coprocessor chip that's built into the 486, the system's price looks quite reasonable. Compared with the rest of the first crop of 33-MHz 486 machines, the Boss 486 performs in the middle of a closely ranked group, with disk and video performance tending slightly toward the slower end of the scale. Its AMI motherboard includes 128K of write-through processor cache using 15-nanosecond chips and the discrete logic that controls it, but the potential benefits of the write-through design didn't give the system any extra edge on our processor and memory benchmark tests. If you choose this computer, you'll choose it for the quality of its hardware, and for its reliable and standard design, relatively painless price, and two-year warranty.

You can install up to 32MB of system RAM in 1MB or 4MB 70-ns. SIMMs. (The test machine came with 8MB in 1MB SIMMs.) You can also install a 32-bit proprietary memory card. Since you can't use this card if you fill up the motherboard with 4MB SIMMs, and since the card takes only 256K or 1MB SIMMs, Boss recommends that you keep your

RAM on your motherboard and save the 32-bit slot for use as a standard 8-bit slot. (The price for a 4MB SIMM is about 20 percent higher than that of four 1MB SIMMs, but since you save slot space, the extra money is well spent.) If the expansion cards you plug into this or other slots are recent models, you can replace a socketed crystal on the motherboard and boost the bus speed from 8 to 12 MHz for the fastest possible input and output through the system.

Boss sent us a machine with a 200MB Maxtor SCSI hard disk and an Adaptec SCSI adapter. The other hard disk options offered for this machine are 300MB and 600MB SCSI models and an 80MB IDE model. The combination of generous expansion slots in the tower case and the multiple-drive capabilities of the SCSI adapter gives this machine enough room for you to build in virtually any storage capacity that you or your network might need. The 300-watt power supply from PC Power and Cooling is strong enough to handle any peripherals, and a knurled knob on the power supply lets you increase the speed of the fan to protect the machine from excess heat.

Boss built this machine with exemplary care. Two of the four I/O ports from the parallel/serial/game card are attached to openings on the back of the case; they don't waste an expansion slot, as on less carefully assembled machines. The back of the case features a removable plastic cover that hides the usual jumble of cables and slots. All in all, the Boss 486 Model 4633 reflects the confidence and experience of its manufacturer—and will increase the confidence of its customers as well.



BOSS 486 Model 4633, \$7,995

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subsystem, flagged register copy back cache and transparent DMA snooping.

ARCHE LEGACY FAMILY PERFORMANCE			
	Legacy 386-25	Legacy 386-33	Legacy 486-33
IBM Power Platform MIPs	8.0	10.21	21.5
AIM Benchmark Dhrystones	13,338	17,966	37,790

Best of all, Legacy workstations and servers are designed around industry-standard and EISA architecture. Assuring compatibility with all your existing AT peripherals, software, networks and operating systems.

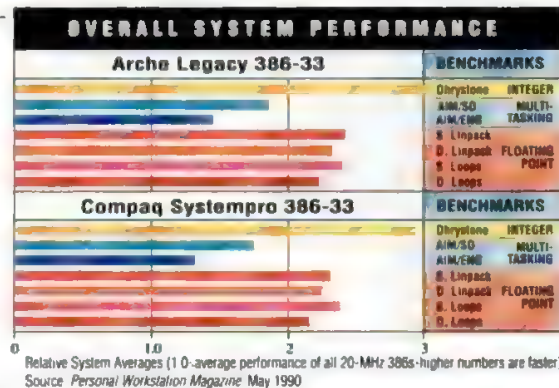
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33-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

Price of standard configuration For this review of 33-MHz 486-based computers, we requested a standard configuration including 8MB RAM, RAM cache if available, a 200MB hard disk or better, one high-density floppy disk drive, a Super VGA color video display subsystem, at least one parallel and two serial ports, a keyboard, and DOS. In some instances, manufacturers do not offer the exact configuration *PC Magazine* requested, but all 30 of the PCs reviewed here provide a reasonably close match for this list of requirements.

All table entries except **price of standard configuration** describe the features of the systems *PC Magazine* actually tested. Refer to each fact file for the price of the tested configuration.

Distribution channel Some machines are sold directly through mail order. When machines are sold by dealers, the purchaser may find discounts of 25 percent or more off the list price (although there is no guarantee that the discounts will run this high).

486 chip set manufacturer indicates which company makes the support logic that connects the CPU with the other functions managed by the system board. In some cases the computer uses discrete logic rather than a chip set.

The **system RAM arrangement** is the method in which memory is addressed. The design of system RAM aims at avoiding the wait states imposed when CPU speed outpaces conventional memory speed. All of the systems in this review run at zero wait states.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages, avoiding wait states.

Row/column is the traditional method of accessing data at a memory address. RAM is mapped as a matrix, and a particular address is given using a row and a column number.

Maximum installable 32-bit RAM Separate rows indicate the maximum 32-bit memory possible on the motherboard and on a dedicated memory board.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs.

The **dual in-line package (DIP)** is the traditional computer chip sprouting 8, 14, 24,

40, or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection.

Single in-line memory modules (SIMMs) consist of individual logic devices installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates easy installation and replacement.

Installed chip size Kb and Mb refer to kilobits and megabits, respectively. Note that combination chips (4x256Kb) are generally faster and more expensive.

The **BIOS version and date** can affect *PC Magazine Labs'* benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in the PC's ROM.

Shadowing Shadow RAM is a technology that loads video BIOS or system BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed. It uses a segment of system memory located between the boundary of conventional memory (640K) and the end of the first megabyte of installed RAM. The ability to disable shadowing is important with some applications to resolve memory conflicts.

Hard disk interface The most common hard disk interfaces are *IDE (integrated drive electronics)*, *SCSI (small computer system interface)*, and *ESDI (enhanced small device interface)*. With an IDE interface, the drive contains its own controller electronics; by contrast, each non-IDE hard disk in this roundup has its controller on a card. IDE can offer good performance at a lower price than ESDI or SCSI.

Fading from popularity is the *RLL (run length limited)* interface, a data encoding technique that is more efficient in packing bits than the older *MFM (modified frequency modulation)* method.

Hard disk options The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available.

Bus speeds Bus speed becomes more important as computers run at faster clock

speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz.

Slots free in fully configured PC indicates the number of open slots after hard and floppy disk drives, a display subsystem, and one parallel and two serial ports are installed.

The **display circuitry** can be either on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it prevents upgrades.

Video interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth. All of the computers in this roundup have 16-bit video interfaces.

DOS The availability and price of DOS 3.3 and 4.01 are listed here. If no price is shown, the base-priced system includes DOS. (*PC Magazine's* standard configuration includes DOS 4.01—or, if it is not available, DOS 3.3—to allow for more-accurate price comparisons.)

Where **OS/2** is available, the version number and list price are provided.

Disk caching software Some companies provide software to facilitate data retrieval from the hard disk. This software speeds overall system performance by anticipating what data the processor will need next.

An **expanded memory manager** is software that emulates the Lotus/Intel/Microsoft (LIM) expanded memory manager within the extended memory of a 386 PC.

Other software is listed if it is bundled free of charge or at a nominal cost.

Dual voltage on the power supply permits a computer's use in both the United States and Europe. All of these computers have this feature.

Number of device connectors indicates how many internal storage devices the system can support without the use of Y cables (power splitters).

FCC certification class The FCC (Federal Communications Commission) rates computers based on radio-frequency emission levels. A Class A rating signifies that a computer has sufficiently low emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

CONTINUES

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THE POWER OF THE '486

The '486 chip is a technological marvel. It includes not only an advanced processor core but also a built-in cache controller, memory cache, floating point math coprocessor, and an advanced memory management unit. Running 40%-50% faster than similar '386 chips, the '486 makes short work of any processor-intensive applications. But where does it *really* shine?

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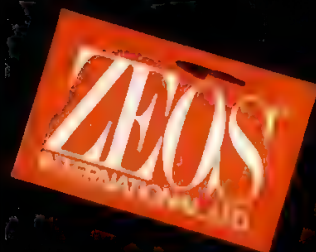
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COVER STORY

33-MHz 486 PCs



33-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	ACMA 486/33 Engineering Workstation	Amax PC/486 Power Station	Arche Legacy ProFile 486-33	Bitwise Model 433	Blackship 486/33I	Blue Star 486/33
Price of standard configuration	\$6,225	\$5,495	\$13,734	\$10,555	\$6,827	\$6,714
Distribution channel	Direct	Dealers	Dealers	Dealers, direct	Direct	Dealers, direct
Case type	Tower	Tower	Tower	Mini-tower	Desktop	Desktop
Dimensions (HWD, in inches)	25.5 x 7.5 x 17.5	25.5 x 7.5 x 17.5	23.5 x 6.5 x 18.8	18.5 x 6.8 x 16	6.5 x 21 x 16.8	6.5 x 21.3 x 16.8
Motherboard manufacturer	AMI	AMI	Arche	AIR	Atronic	Blue Star
386 chip set manufacturer	C&T	C&T	Arche	C&T, discrete logic	Discrete logic	Discrete logic
System RAM arrangement	Page-mode	Page-mode	Bank interleaved	Interleaved	Interleaved, page-mode	Interleaved, page-mode
Installable RAM (minimum-maximum)	4MB-24MB	1MB-16MB	2MB-64MB	1MB-16MB	16MB	16MB
MOTHERBOARD MEMORY						
Installed RAM	8MB	8MB	8MB	N/A	8MB	8MB
Maximum installable 32-bit RAM	8MB	8MB	64MB	N/A	8MB	16MB
RAM packaging (and rated speed)	SIMM (60 ns.)	SIMM (60 ns.)	SIMM (80 ns.)	N/A	SIMM (80 ns.)	SIMM (60 ns.)
Installed chip size	1Mb	1Mb	1Mb	N/A	1Mb	1Mb
Other chips supported	256Kb	256Kb	2Mb, 4Mb, 8Mb	N/A	256Kb	256Kb
ADD-IN MEMORY BOARD						
Installed RAM	None	None	N/A	8MB	None	N/A
Maximum installable 32-bit RAM	16MB	16MB	64MB	16MB	8MB	N/A
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	SIMM (70 ns.)	SIMM (80 ns.)	N/A
Installed chip size	N/A	N/A	N/A	1Mb	N/A	N/A
Other chips supported	256Kb, 1Mb	256Kb, 1Mb	1Mb	256Kb, 1Mb	256Kb, 1Mb	N/A
PROCESSOR RAM CACHE						
Cache controller	Discrete logic	Discrete logic	Discrete logic	N/A	Discrete logic	Discrete logic
Installed RAM	128K	128K	256K	N/A	64K	128K
Installable RAM options	128K	128K	256K	N/A	32K, 64K	128K
RAM packaging (and rated speed)	DIP (25 ns.)	DIP (25 ns.)	SIMM (20 ns.)	N/A	DIP (25 ns.)	DIP (35 ns.)
Installed chip size	64Kb	64Kb	128Kb	N/A	64Kb	64Kb
BIOS						
BIOS version and date	AMI (April 1990)	AMI (April 1990)	AMI/Arche (September 1990)	AMI (May 1990)	AMI (September 1990)	AMI (May 1990)
Setup/password in ROM	■/□	■/□	■/■	■/□	■/□	■/□
System shadowing/Can be disabled	■/□	■/□	■/■	■/■	■/■	■/■
Video shadowing/Can be disabled	■/■	■/■	■/■	■/■	■/■	■/■
HARD DISK						
Manufacturer	Rodime	Maxtor	Seagate	Maxtor	Maxtor	Seagate
Disk capacity	210MB	355MB	338MB	201MB	202MB	208MB
Interface	IDE	SCSI	ESDI	SCSI	ESDI	IDE
Controller manufacturer	N/A	Adaptec	UltraStor	Adaptec	Western Digital	N/A
Integrated floppy/hard disk controller	□	■	■	■	■	□
Drive bays	6 half-height	6 half-height	2 half-height, 2 full-height, 2 3.5-inch	3 half-height, 4 3.5-inch	5 half-height	5 half-height

■—Editors' Choice ■—Yes □—No

N/A—Not applicable: The product does not have this feature.

AMI—American Megatrends Inc., C&T—Chips and Technologies Inc., VSLI Tech—Very Large Scale Integration Technologies Inc.

COVER STORY

33-MHz 486 PCs

Boss 486 Model 4633	 Club Hawk II/II Club Hawk II/II	Computer Market Place Ultra 486-33	Diamond 486-33	Dynamic Decisions Dynex 486	Dyna Work Master 486 33 Cache	Eltech Model 486-33	Fortron NetSet 433I	International Instrumentation Blue Max Monolith 486/33
\$7,995	\$6,100	\$4,628	\$4,999	\$7,495	\$7,979	\$5,559	\$5,495	\$8,997
Dealers, direct Tower	Direct Tower	Direct Tower	Direct Tower	Dealers Tower	Dealers Tower	Direct Desktop	Direct Desktop	Dealers Desktop
24 x 7.2 x 17.2 AMI	25.8 x 8.5 x 20.3 Club	25.5 x 7.5 x 17.3 Cache Computers	25.5 x 7.5 x 17.5 AMI	25.5 x 7.5 x 17.5 AMI	24.3 x 7.3 x 16.5 AIR	6.8 x 21 x 16.3 AMI	6.5 x 21 x 16 AMI	6.5 x 21 x 16 AMI
Discrete logic	Discrete logic	Opti	C&T	C&T	C&T, discrete logic	Discrete logic	C&T	Discrete logic
Interleaved page-mode 1MB-32MB	Static column, page-mode 16MB	Interleaved, page-mode 16MB	Page-mode 24MB	Page-mode 32MB	Row/column 1MB-16MB	Interleaved, page-mode 2MB-32MB	Interleaved 4MB-32MB	Interleaved, page-mode 2MB-16MB
8MB 32MB SIMM (70 ns.) 1Mb 256Kb, 4Mb	8MB 8MB SIMM (70 ns.) 1Mb 256Kb	8MB 16MB SIMM (70 ns.) 1Mb 256Kb	8MB 8MB SIMM (60 ns.) 1Mb 256Kb	8MB 8MB SIMM (80 ns.) 1Mb 256Kb	8MB 16MB SIMM (70 ns.) 1Mb 256Kb	8MB 8MB SIMM (80 ns.) 1Mb 256Kb, 4Mb	8MB 32MB DIP, SIMM (70 ns.) 1Mb 256Kb, 4Mb	8MB 32MB SIMM (70 ns.) 1Mb 256Kb, 4Mb
None 16MB SIMM (70 ns.) N/A 256Kb, 1Mb	None 8MB SIMM (80 ns.) N/A 256Kb, 1Mb	N/A N/A N/A N/A N/A	None 16MB SIMM (80 ns.) N/A 256Kb, 1Mb	None 8MB SIMM (80 ns.) N/A 256Kb, 1Mb	N/A N/A N/A N/A N/A	None 8MB SIMM (80 ns.) N/A 256Kb, 1Mb, 4Mb	None 16MB SIMM (70 ns.) N/A 1Mb	None 8MB DIP (70 ns.) N/A 256Kb, 1Mb, 4Mb
Discrete logic 128K 128K DIP (15 ns.) 64Kb	Discrete logic 256K 64K, 256K DIP (20 ns.) 64Kb	Opti 128K 128K DIP (25 ns.) 64Kb	Discrete logic 128K 128K DIP (25 ns.) 64Kb	Discrete logic 128K 128K DIP (25 ns.) 64Kb	Discrete logic 256K 256K DIP (30 ns.) 256Kb	Discrete logic 128K 128K DIP (25 ns.) 8x8Kb	Discrete logic 64K 64K DIP (15 ns.) 4x16Kb	Discrete logic 128K 128K DIP (25 ns.) 64Kb
AMI (April 1990) ■/□ ■/□ ■/■	AMI (April 1990) ■/□ □/□ □/□	BAT 486 1.07 (August 1990) ■/■ ■/□ ■/■	AMI (April 1990) ■/□ ■/□ ■/■	AMI (April 1990) ■/□ ■/□ ■/■	AMI (May 1990) ■/□ ■/■ ■/■	AMI (April 1990) ■/□ ■/□ ■/■	AMI (April 1990) ■/□ ■/■ ■/■	AMI (April 1990) ■/□ ■/□ ■/■
Maxtor 200MB SCSI Adaptec ■	Maxtor 338MB ESDI UltraStor ■	Imprimis 211MB IDE N/A □	Seagate 360MB ESDI UltraStor ■	Conner 213MB IDE N/A □	Seagate 320MB ESDI UltraStor ■	Seagate 314MB SCSI DTC ■	Maxtor 207MB IDE N/A ■	CMS 344MB ESDI Adaptec ■
5 half-height, 2 3.5-inch	9 half-height	6 half-height	6 half-height	6 half-height	6 half-height	5 half-height	5 half-height	5 half-height

CONTINUES



33-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Micro Express ME 486-ISA/33	Micro Telesis 486/33	National Micro Systems Flash 486-33	Northgate Elegance 486/33	Novas OPTimum 486-33	Panther 486/33
Price of standard configuration	\$7,224	\$7,199	\$4,999	\$7,095	\$6,601	\$4,999
Distribution channel	Direct	Dealers, direct	Direct	Direct	Direct	Direct
Case type	Tower	Mini-tower	Tower	Tower	Tower	Tower
Dimensions (HWD, in inches)	24.5 x 9 x 23	16 x 8.5 x 19	25.5 x 8 x 18	25.3 x 7.3 x 16.5	24.5 x 8.8 x 20	25 x 7.5 x 16
Motherboard manufacturer	Micro Express	SIC Research	AMI	Motherboard Factory	Novacor	Award
386 chip set manufacturer	Discrete logic	Discrete logic	Discrete logic	Discrete logic	Opti	Opti
System RAM arrangement	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Page-mode	Page-mode	Interleaved, page-mode
Installable RAM (minimum—maximum)	2MB—16MB	2MB—16MB	2MB—24MB	2MB—16MB	1MB—32MB	2MB—16MB
MOTHERBOARD MEMORY						
Installed RAM	8MB	8MB	8MB	8MB	8MB	8MB
Maximum installable 32-bit RAM	16MB	8MB	8MB	8MB	32MB	16MB
RAM packaging (and rated speed)	SIMM (60 ns.)	SIMM (70 ns.)	SIMM (70 ns.)	SIMM (70 ns.)	SIMM (70 ns.)	SIMM (70 ns.)
Installed chip size	1Mb	1Mb	1Mb	1Mb	1Mb	1Mb
Other chips supported	256Kb, 4Mb	256Kb, 4Mb	256Kb, 4Mb	256Kb	256Kb	256Kb, 4Mb
ADD-IN MEMORY BOARD						
Installed RAM	N/A	None	None	8MB	None	N/A
Maximum installable 32-bit RAM	N/A	8MB	16MB	8MB	8MB	N/A
RAM packaging (and rated speed)	N/A	SIMM (70 ns.)	SIMM (80 ns.)	SIMM (70 ns.)	SIMM (80 ns.)	N/A
Installed chip size	N/A	N/A	N/A	1Mb	N/A	N/A
Other chips supported	N/A	256Kb, 1Mb, 4Mb	256Kb, 1Mb, 4Mb	256Kb	256Kb, 1Mb	N/A
PROCESSOR RAM CACHE						
Cache controller	Discrete logic	Discrete logic	Discrete logic	Discrete logic	N/A	N/A
Installed RAM	128K	64K, 128K	128K	64K	N/A	N/A
Installable RAM options	128K	128K	128K	64K, 256K	N/A	N/A
RAM packaging (and rated speed)	DIP (35 ns.)	DIP (15 ns.)	DIP (25 ns.)	DIP (15 ns.)	N/A	N/A
Installed chip size	8x32Kb	128Kb	64Kb	64Kb	N/A	N/A
BIOS						
BIOS version and date	AMI (May 1990)	AMI (April 1990)	AMI (April 1990)	AMI (April 1990)	MR BIOS (1990)	Award 3.10 (1990)
Setup/password in ROM	■/□	■/□	■/□	■/□	■/■	■/□
System shadowing/Can be disabled	■/■	□/□	■/□	□/□	■/■	■/■
Video shadowing/Can be disabled	■/■	□/□	■/■	□/□	■/■	■/■
HARD DISK						
Manufacturer	Seagate	Rodime	Maxtor	Maxtor	Conner	Maxtor
Disk capacity	330MB	200MB	344MB	200MB	212MB	200MB
Interface	ESDI	IDE	ESDI	IDE	IDE	IDE
Controller manufacturer	UltraStor	N/A	UltraStor	N/A	N/A	N/A
Integrated floppy/hard disk controller	■	□	■	□	■	■
Drive bays	10 half-height	5 half-height	8 half-height	7 half-height	5 half-height, 2 full-height	6 half-height

■—Editors' Choice ■—Yes □—No

N/A—Not applicable: The product does not have this feature.

AMI—American Megatrends Inc., C&T—Chips and Technologies Inc., VSLI Tech—Very Large Scale Integration Technologies Inc.

COVER STORY

33-MHz 486 PCs

PC Brand 486/33	PC Pros/Touche 486-33 Model 5550	Peregrine 486/33 Flyer	SAI 486/33	Standard 486/33	Systems Integration Associates SIA 486/33	Tangent 433i	Tri-Star Flash Cache 486	Twinhead Superset 600/433
\$5,908	\$5,499	\$6,999	\$5,508	\$5,995	\$10,555	\$7,190	\$6,245	\$6,225
Direct Desktop	Direct Tower	Dealers, direct Tower	Direct Desktop	Direct Mini-tower	Dealers Tower	Direct Tower	Direct Tower	Dealers Desktop
6.5 x 18.9 x 15.9 PC Brand	25 x 7.5 x 17.5 AMI	24.5 x 7.5 x 18.5 AMI	6 x 21 x 16 AIR	14.5 x 8.5 x 16.5 AMI	29.5 x 9 x 23.5 SIA	25.6 x 7.5 x 17.3 AIR	24.3 x 8.8 x 19.3 TP Enterprise	5.8 x 15.8 x 15.8 Twinhead
Opti	C&T	Discrete logic	Intel	C&T	Discrete logic	C&T, discrete logic	VLSI Tech, discrete logic	C&T
Interleaved, page-mode 1MB-32MB	Page-mode 4MB-32MB	Interleaved 1MB-8MB	Interleaved, page-mode 2MB-16MB	Row/column 1MB-32MB	Interleaved, page-mode 1MB-32MB	Interleaved, page-mode 1MB-16MB	Row/column 1MB-16MB	Interleaved, page-mode 1MB-16MB
8MB	8MB	8MB	8MB	8MB	8MB	8MB	8MB	8MB
32MB	64MB	8MB	16MB	32MB	32MB	16MB	8MB	8MB
SIMM (70 ns.)	SIMM (70 ns.)	SIMM (60 ns.)	SIMM (70 ns.)	SIMM (70 ns.)	SIMM (80 ns.)	SIMM (70 ns.)	SIMM (80 ns.)	SIMM (60 ns.)
9x1Mb	1Mb	1Mb	1Mb	1Mb	9x1Mb	1Mb	1Mb	8x1Mb
4x256Kb, 1Mb, 4Mb	1Mb, 4Mb	4Mb	256Kb	4x256Kb, 4Mb	256Kb, 1Mb, 4Mb	256Kb	4Mb	256Kb, 1Mb
N/A	None	None	N/A	None	None	N/A	None	None
N/A	32MB	16MB	N/A	16MB	32Mb	N/A	8MB	8MB
N/A	SIMM (70 ns.)	SIMM (60 ns.)	N/A	SIMM (70 ns.)	SIMM (80 ns.)	N/A	DIP (80 ns.)	SIMM (60 ns.)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	1Mb, 4Mb	256Kb, 1Mb	N/A	1Mb	256k, 1Mb, 4Mb	N/A	1Mb	256Kb, 1Mb
Intel	Proprietary	Discrete logic	Intel	Discrete logic	Discrete logic	Discrete logic	Proprietary	Proprietary
None	128K	128K	128K	128K	128K	128K	64K	64K
256K	256K	128K	128K, 256K	128K	128K	128K	64K, 256K	64K
DIP (25 ns.)	DIP (25 ns.)	DIP (25 ns.)	DIP (30 ns.)	DIP (25 ns.)	DIP (25 ns.)	DIP (20 or 25 ns.)	DIP (15 ns.)	SIMM (25 ns.)
8x32K	64Kb	128Kb	256Kb	64Kb	64Kb	64Kb	4x16Kb	8x64Kb
Microid Research 1.08 (1990)	AMI (April 1990)	AMI (April 1990)	AMI (May 1990)	AMI (1990)	AMI (April 1990)	AMI (December 1989)	AMI (April 1990)	Phoenix 1022 CA (1990)
■/■	■/□	■/□	■/□	■/□	■/□	■/□	■/□	■/□
■/■	□/□	■/□	■/■	■/□	■/■	■/■	□/□	■/■
■/■	■/■	■/■	■/■	■/■	■/■	■/■	□/□	■/■
Maxtor 200MB	Maxtor 338MB	Maxtor 200MB	Conner 212MB	Maxtor 200MB	Imprimis 322MB	Maxtor 200MB	Maxtor 200MB	Conner 204MB
IDE	ESDI	IDE	IDE	IDE	ESDI	IDE	IDE	IDE
N/A	UltraStor	N/A	N/A	N/A	Adaptec	N/A	Silicon Valley	N/A
■	■	■	■	■	■	■	■	■
4 half-height, 2 3.5-inch	6 half-height or 3 full-height	6 half-height	5 half-height	3 half-height, 2 3.5-inch	10 half-height	6 half-height	5 half-height, 3 full-height	1 half-height, 2 one-third-height, 1 3.5-inch

CONTINUES

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As the people responsible for the Microsoft Windows™ graphical environment, we believe we're in a good position to offer some very sound advice on Windows computing. And

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You see, the Mouse allows you to navigate the Windows environment and applications with untold ease, as

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Visit a dealer and check it out for yourself. We think you'll see our point.

Microsoft
Making it all make sense[®]



33-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	ACMA 486/33 Engineering Workstation	Amax PC/486 Power Station	Arche Legacy ProFile 486-33	Bitwise Model 433	Blackship 486/33I	Blue Star 486/33
HARD DISK						
Hard disk options	338MB, 676MB (ESDI); 80MB, 105MB, 150MB (IDE)	300MB, 600MB (ESDI); 105MB, 210MB (IDE)	180MB, 380MB (ESDI); 44MB, 104MB (IDE)	330MB (ESDI); 330MB, 600MB (SCSI)	150MB, 330MB, 676MB (ESDI); 80MB (IDE)	330MB (ESDI); 71MB, 120MB (IDE); 1.2GB (SCSI)
FLOPPY DISK DRIVES						
Type	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB
Manufacturer	TEAC	TEAC	TEAC	Adaptec	TEAC	Toshiba
EXPANSION BUS						
Bus speeds (MHz)	8, 12	8, 12	8, 11	8	8	8
Slots (8-, 16-, 32-bit)	1, 6, 1	1, 6, 1	2, 6, 0	2, 5, 1	2, 5, 1	0, 1, 0
Slots free in fully configured PC	5	5	5	4	6	5
Ports originate on motherboard	☐	☐	☐	☐	☐	☐
VIDEO						
Display circuitry location	Card	Card	Card	Card	Card	Card
Manufacturer	Orchid	Orchid	Arche	Trident	Orchid	SpeedStar
Chip set manufacturer	Tseng	Tseng	Tseng	Trident	Tseng	Tseng
KEYBOARD/MOUSE						
Manufacturer	Maxi-Switch	Maxi-Switch	Hi-Tek	Key Tronic	Key Tronic	Nan Tan
Number of keys, function keys	101, 12	101, 12	101, 12	101, 12	101, 12	101, 12
Keyboard cable length (inches)	66	66	108	90	90	66
Mouse port	☒	☒	☐	☐	☐	☒
SOFTWARE INCLUDED						
DOS	4.01	4.01	3.3, 4.01 (\$159)	3.3, 4.01	3.3, 4.01 (\$75)	3.3, 4.01 (\$65)
OS/2	None	None	None	1.0 (\$150)	None	None
Disk caching software	None	None	None	None	None	None
Expanded memory manager	None	None	None	Micronics EMS 4.0	None	None
Other	None	Windows 3.0	None	None	None	None
MISCELLANEOUS						
Coprocessor supported	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167
Physical features:						
Power supply (watts)	450	250	220	200	220	200
Dual voltage	☒	☒	☒	☒	☒	☒
Number of device connectors	5	4	4	4	4	4
Keyboard/case lock	Front/none	Front/none	Front/none	Front/none	Front/front	Front/none
Power-on/reset switch	Front/front	Front/front	Front/front	Front/front	Side/front	Side/front
Warranty	1 year parts, 2 years labor	1 year	2 years	1 year	1 year	1 year
Service	On-site	Vendor	Dealer	Vendor	On-site	On-site
FCC certification class	A	A	B	A (B pending)	B	A

☒—Editors' Choice ☒—Yes ☐—No

N/A—Not applicable: The product does not have this feature.

COVER STORY

33-MHz 486 PCs

Boss 486 Model 4633	 Club Hawk III/II Ultra 486-33	Computer Market Place Ultra 486-33	Diamond 486-33	Dynamic Decisions Dynex 486	Dyna Work Master 486 33 Cache	Elitech Model 486-33	Fortron NetSet 4331	International Instrumentation Blue Max Monolith 486/33
80MB (IDE); 300MB, 600MB (SCSI)	150MB, 651MB (ESDI); 44MB, 71MB (MFM)	106MB, 150MB, 300MB (ESDI); 676MB (SCSI)	750MB (ESDI); 100MB, 200MB (IDE)	300MB (ESDI); 300MB (SCSI)	106MB, 182MB, 383MB (ESDI)	600MB (SCSI)	150MB, 300MB (ESDI); 200MB (IDE); 300MB (SCSI)	600MB (ESDI); 300MB, 600MB (SCSI)
1.2MB, 1.44MB TEAC	1.2MB TEAC	1.2MB, 1.44MB Mitsumi	1.2MB, 1.44MB YE Data	1.2MB, 1.44MB TEAC	2 1.2MB, 1 1.44MB TEAC	1.2MB, 1.44MB Toshiba	1.2MB TEAC	1.2MB, 1.44MB Fujitsu
8, 12 2, 6, 1 5 	8 0, 7, 1 5 	8 1, 7, 0 5 	7, 8, 9 1, 6, 1 5 	8 1, 6, 1 5 	8 0, 8, 0 3 	8 2, 6, 1 5 	8, 12 1, 6, 1 6 	8 2, 6, 1 5 
Card Cardinal C&T	Card Club Tseng	Card Renaissance XILINX	Card Orchid Tseng	Card ATI Tseng	Card Orchid Tseng	Card Diamond Tseng	Card Fortron Western Digital	Card Headland G2
Honeywell 101, 12 60 	NMB 101, 12 72 	Focus 120, 24 90 	Maxi-Switch 101, 12 66 	Chicony 101, 12 60 	Honeywell 101, 12 96 	NMB 101, 12 84 	NMB 101, 12 72 	Maxi-Switch 101, 12 72 
4.01 None None None None	4.01 None None None Windows 3.0	3.3, 4.01 None None None None	3.3, 4.01 (\$85) None None None None	3.3, 4.01 (\$70) None None None None	3.3, 4.01 None None None None	4.01 1.2 (\$395) None Control 386 Windows 3.0	4.01 1.2 (\$299) PC-Kwik 4.2 None None	4.01 (\$99) 1.2 (\$399) None None None
Weitek 4167 300  4 Front/front Front/front 2 years Dealer, vendor, on-site A	Weitek 4167 250  5 Front/back Front/front 1 year On-site B	None 220  6 Front/none Front/front 1 year; 18 months motherboard On-site A	Weitek 4167 220  6 Front/none Front/front 15 months Vendor A	Weitek 4167 230  4 Front/none Front/front 1 year; 9 months hard disk On-site, dealer A	Weitek 4167 250  4 Front/none Front/front 1 year On-site A	Weitek 4167 200  4 Front/none Side/front 1 year On-site A	Weitek 4167 200  4 Front/none Side/front 1 year On-site A	Weitek 4167 230  4 Front/none Side/front 1 year Vendor A

CONTINUES

POWER STATION

33-MHz 486 PCs



33-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Micro Express ME 486-ISA/33	Micro Teleals 486/33	National Micro Systems Flash 486-33	Northgate Elegance 486/33	Novas OPTimum 486-33	Panther 486/33
HARD DISK						
Hard disk options	750MB (ESDI); 200MB (IDE)	150MB, 300MB 600MB, 1.2GB (ESDI)	150MB, 300MB, 600MB (ESDI)	300MB, 600MB (ESDI); 300MB, 600MB (SCSI)	380MB (ESDI); 40MB, 100MB, 200MB (IDE)	300MB, 600MB (ESDI); 300MB, 600MB (SCSI)
FLOPPY DISK DRIVES						
Type	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB
Manufacturer	YE Data	Panasonic	TEAC	TEAC	TEAC	Chinon
EXPANSION BUS						
Bus speeds (MHz)	8	8	8	8	8, 10, 12	8
Slots (8-, 16-, 32-bit)	0, 8, 0	0, 7, 1	2, 6, 1	1, 6, 1	1, 5, 2	0, 8, 0
Slots free in fully configured PC	5	6	5	5	4	5
Ports originate on motherboard	☐	☒	☐	☒	☐	☐
VIDEO						
Display circuitry location	Card	Card	Card	Card	Card	Card
Manufacturer	Micro Express	EMK-16 VGA1024	Ahead	Orchid	Novas	Paradise
Chip set manufacturer	Tseng	Western Digital	Ahead	Tseng	C&T	Paradise
KEYBOARD/ MOUSE						
Manufacturer	Focus	SIC Research	Maxi-Switch	Northgate	Maxi-Switch	Chicony
Number of keys, function keys	101, 12	101, 12	101, 12	119, 24	101, 12	101, 12
Keyboard cable length (inches)	84	84	72	84	74	84
Mouse port	☐	☒	☐	☐	☐	☐
SOFTWARE INCLUDED						
DOS	4.01 (\$75)	4.01	3.3	4.01	3.3, 4.01	4.01
OS/2	1.1 (\$279)	2.21 (\$325)	None	1.2 (\$249)	None	1.2 (\$300)
Disk caching software	None	SmartDrive	None	None	None	None
Expanded memory manager	None	None	None	None	None	None
Other	None	Windows 3.0	None	Ami Professional, Windows 3.0, Wingz	None	None
MISCELLANEOUS						
Coprocessor supported	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	None
Physical features:						
Power supply (watts)	250	200	230	200	275	200
Dual voltage	☒	☒	☒	☒	☒	☒
Number of device connectors	5	4	4	4	6	4
Keyboard/case lock	Front/front	Front/none	Front/none	Front/none	Front/back	Front/none
Power-on/reset switch	Front/front	Front/front	Front/front	Front/front	Front/front	Front/front
Warranty	2 years	13 months	15 months parts, 2 years labor	1 year	1 year	1 year; 3 years boards
Service	Vendor	Vendor	Vendor	On-site	Vendor	On-site
FCC certification class	A	A	A	B	A	A

☒—Editors' Choice ☒—Yes ☐—No

N/A—Not applicable: The product does not have this feature.

COVER STORY

33-MHz 486 PCs

PC Brand 486/33	PC Pros/Touche 486-33 Model 5550	Peregrine 486/33 Flyer	SAI 486/33	Standard 486/33	Systems Integration Associates SIA 486/33	Tangent 433i	Tri-Star Flash Cache 486	Twinhead Superset 600/433
320MB, 640MB, (ESDI); 40MB, 89MB, 120MB, 170MB (IDE)	676MB (ESDI)	300MB, 600MB (ESDI); 300MB, 600MB (SCSI)	150MB, 300MB (ESDI); 150MB, 300MB (IDE)	100MB, 300MB, 600MB (ESDI)	90MB, 680MB, 1.2GB (ESDI)	360MB, 650MB, 1GB (ESDI); 300MB, 360MB, 600MB, 650MB, 1GB (SCSI)	150MB, 330MB, 660MB (ESDI); 104MB (IDE); 65MB (RLI); 660MB, 1.2GB (SCSI)	100MB, 300MB, 500 MB (IDE)
1.2MB Mitsumi	1.2MB, 1.44MB TEAC	1.2MB, 1.44MB TEAC	1.2MB, 1.44MB TEAC	1.2MB, 1.44MB TEAC	1.2MB Fujitsu	1.2MB TEAC	1.2MB, 1.44MB Mitsumi	1.2MB, 1.44MB Canon, TEAC
8.25, 11, 16.5 0, 7, 0 5 □	8, 12 1, 6, 1 5 □	8 1, 6, 1 6 □	8, 12 0, 8, 0 6 □	6, 16 2, 6, 0 5 □	8, 16 2, 6, 0 5 □	10 0, 8, 0 5 □	8 0, 6, 1 6 ■	8 0, 4, 0 4 ■
Card PC Brand Tseng	Card Orchid Tseng	Card Orchid Tseng	Card Western Digital Western Digital	Card Trident Trident	Card SIA SIA	Card Orchid Tseng	Card STB Tseng	Motherboard Twinhead Paradise
Monterey 101, 12 60 □	Key Tronic 101, 12 72 □	NMB 101, 12 60 □	Focus 2001 101, 12 60 □	NMB 101, 12 60 □	Maxi-Switch 101, 12 65 □	Key Tronic 101, 12 72 None	Nan Tan 101, 10 66 □	Focus 101, 12 104 □
4.01 (\$70) None None None None	4.01 None None None None	4.01 None <i>SmartDrive</i> LIM 4.0 <i>Windows 3.0</i>	3.3, 4.01 (\$69) None None None None	4.01 None None <i>LimSim 4.0</i> None	3.3, 3.31 (\$100) None None <i>Larson 4.10</i> None	4.01 None None None None	4.01 None None None None	4.01 None None None None
Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	Weitek 4167	None
200 ■ 4 Front/none Front/front 5 years parts, 1 year labor On-site, vendor A	250 ■ 4 Front/front Front/front 1 year On-site B	300 ■ 10 Front/none Front/front 1 year Vendor A	200 ■ 4 Front/front Side/front 1 year parts, 3 years labor Vendor A	200 ■ 5 Front/none Front/front 1 year On-site, vendor A	450 □ 8 Front/front Front/front 1 year On-site A	300 ■ 4 Front/none Front/front 2 years Dealer, vendor, on-site A	250 ■ 6 None/none Front/front 2 years Vendor A	145 ■ 4 Front/none Front/front 1 year On-site A (B pending)

ENDS

Shelling out an extra \$10,000 for a Compaq SystemPro with chancey service is appalling. With that kind of iffy support, they should be paying you the ten grand.

On the other hand, Dell's i486™ servers come with the same service that's won an unprecedented 8 PC Week Corporate Satisfaction Polls for PCs, laptops and servers.

Spend less. Get more. Sounds better, doesn't it?

We have two new i486 EISA servers.

Dell gives you a choice of the 25 MHz Dell® 425TE and the 33 MHz Dell 433TE.

The 25 MHz Dell System® 425TE has up to 64 MB of RAM capacity, 11 storage bays, and a

supply. We've also built in features such as password protection, a software controlled reset switch, and an efficient cooling system to protect component life.

What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

For even more performance, the 33 MHz Dell System 433TE is everything our 425TE is, with 32% more speed. The Dell exclusive memory design with a 128 KB external cache gives it maximum throughput.

APPEALING.



THE NEW DELL SYSTEM 433TE 33 MHz EISA i486 AND 425TE 25 MHz EISA i486.

Standard features:

- Intel® i486 microprocessor running at 33 MHz (433TE) or 25 MHz (425TE) with 8 KB internal cache
- 128 KB external cache (433TE)
- Standard 4 MB of RAM,* expandable to 64 MB (eight internal SIMM sockets, each accepting a 1 MB, 2 MB, 4 MB or 8 MB SIMM, unavailable in matched pairs)
- Socket for WEITEK 4167 math coprocessor
- 11 internal half-height drive bays
- Eight 32-bit EISA expansion slots (six EISA master slots and two EISA slave slots)
- High-performance IDE (80 MB, 100 MB, 190 MB) and ESDI (330 MB, 650 MB) hard disk drives

650 MB VGA Color Plus System
Using 4 MB SIMMS

433TE	425TE
\$12,199	\$9,999

Prices listed include 8 MB of RAM



AD CODE 11897

APPALLING.

\$24,698

Compaq SystemPro 486/33
Comparably configured.



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the most demanding server use—a multi-function network. Of course, they're completely compatible with all major network operating systems, including Novell, 3COM, Banyan and LAN Manager.

The 425TE and 433TE are perfect for UNIX® workgroups, supporting either character-based, multi-user or graphical-based client/server environments. You can buy Dell servers preloaded with UNIX System V, making them literally plug and play. Even more impressive is the fact that UNIX system administration can be done by Dell, remotely.

Maintaining servers can be beyond most computer repairmen. If a server goes down, your whole company can go down with it.

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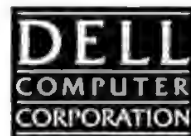
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**CLUB AMERICAN
TECHNOLOGIES INC.**

Club Hawk IIITi

by Bruce Brown

Need lots of drives? Need a secure case that will keep out prying fingers? Then consider Club American Technologies' Club Hawk IIITi. This machine's tower case is the same one used for Club AT's 33-MHz 386, the Club Hawk I (reviewed in "386/33 PCs: At the Peak of Their Careers," *PC Magazine*, January 15, 1991)—and that case is a tamper-resistant, spacious beauty. When you factor in other considerations, such as better-than-average performance, a very competitive list price, and good service and support policies, you're likely to conclude that the Hawk IIITi is a leader of its class.



Club Hawk IIITi, \$6,100

The \$6,100 tested system conformed to the standard configuration we requested. It included 8MB of RAM, a 256K processor RAM cache, a 16-millisecond 338MB Maxtor ESDI hard disk, an UltraStor floppy/hard disk controller with a 32K buffer, a 1.2MB TEAC floppy disk drive, Club AT's Super VGA video adapter and monitor, one parallel and two serial ports, a 101-key NMB keyboard (with an extension for a total cable length of 12 feet), DOS 4.01, *Microsoft Windows* 3.0, and a Microsoft bus mouse—all fine components at an attractive price.

The Hawk IIITi's case measures 25.8 by 8.5 by 20.3 inches; the width becomes 11 inches with the attachable stand. There is space for nine half-height drives, five of which can use removable media. A hinged door covers the drives, which are accessible through the front of the chassis, as

COVER STORY
33-MHz 486 PCs

well as the power, reset, and turbo switches and the electronic keyboard lock. A separate case lock is on the back. A Skynet Electronics 250-watt power supply with five power connectors drives the PC.

The machine uses Club's own motherboard, which is based on discrete logic, and an AMI BIOS. The system does not support ordinary RAM shadowing of system or video BIOS; instead, video BIOS is shadowed directly in the 486 CPU's internal 8K cache. The external processor RAM cache (256K in the tested system, but also available with 64K) uses 20-nanosecond static-RAM DIP chips for direct-mapped write-back caching. The processor can operate at either 8 or 34 MHz, and the bus runs at 8 MHz. The motherboard has a socket for a 33-MHz Weitek 4167 math coprocessor.

The Hawk IIITi can handle a maximum of 16MB of static-column or fast page-mode system RAM, of which 8MB fits on the motherboard; in our tested system, the 1MB SIMMs were rated at 70 ns. The remaining system RAM resides on an optional \$150 memory expansion card. At the time of this review, Club AT was selling memory at \$60 per megabyte.

The memory card fits in the Hawk IIITi's single 32-bit expansion slot, which

otherwise can accommodate a 16-bit card. The motherboard has seven other 16-bit slots, five of which were vacant in our tested system.

The Hawk IIITi fared very well on PC Magazine Labs' benchmark tests. Its processor and memory times were about average for the group, but its drive times were better than average and its video times were near the top of the pack.

The Hawk IIITi comes with FCC Class B certification and a one-year parts-and-labor warranty, and it is backed by on-site service from GE. In addition, Club AT provides toll-free technical support lines and a 30-day money-back guarantee—all good policies.

If you think a 33-MHz 486 machine is overkill for your needs, Club AT's 386/33 (Hawk I) is still a good choice. But if you want to bet on the top of the current classes of systems, you'll win big with the Club Hawk IIITi.

**COMPUTER
MARKET PLACE INC.**
Ultra 486-33

by Bruce Brown

If you can resist anything except a low price, you may find yourself the owner of Computer Market Place's Ultra 486-33, one of the least expensive 33-MHz 486 machines around. Fortunately, you won't have to sacrifice support and service to keep your costs down.

Sold through the mail from Computer Market Place's Pennsylvania facility, the Ultra 486-33 comes configured just about any way you could possibly want. If you wanted to purchase *PC Magazine's* standard configuration, you'd pay just \$4,628 for a tower model that includes 8MB of RAM, a 128K processor RAM cache, a 15-millisecond 211MB Imprimis IDE hard disk, a 1.2MB Mitsumi floppy disk drive, a ZPVGA video adapter with 512K of video RAM, a CTX Super VGA interlaced monitor with a maximum resolution of 1,024 by 768 pixels, one parallel and two serial ports, a game port, a 101-key keyboard, and DOS 4.01. Stripped down to its \$3,334 basic configuration, the system provides 2MB of RAM; the same cache, floppy disk drive, ports, and keyboard; a Hercules video adapter and monochrome monitor; and either DOS 3.3 or 4.01.

Our tested system came with a 1.44MB

FACT FILE
EDITORS' CHOICE

Club Hawk IIITi
Club American Technologies Inc., 3401 W. Warren Ave., Fremont, CA 94539; 415-683-6600.

List Price: With 4MB RAM, 64K cache, 150MB hard disk, 1.2MB or 1.44MB floppy disk drive with ESDI controller, one parallel and two serial ports, Super VGA color adapter, VGA monitor, DOS 4.01, \$5,725; with 8MB RAM, 256K RAM cache, 338MB hard disk, 1.2MB floppy disk drive, Super VGA color display, *Microsoft Windows* 3.0, Microsoft Mouse, \$6,100.

In Short: This large system has a case with room for nine half-height drives, plus keyboard and case locks, casters, and handle. It's an above-average performer—with 16MB memory capacity—sold at a fair mail-order price and backed by GE on-site service.



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# Drives on-line	0-7	0-2	0-2
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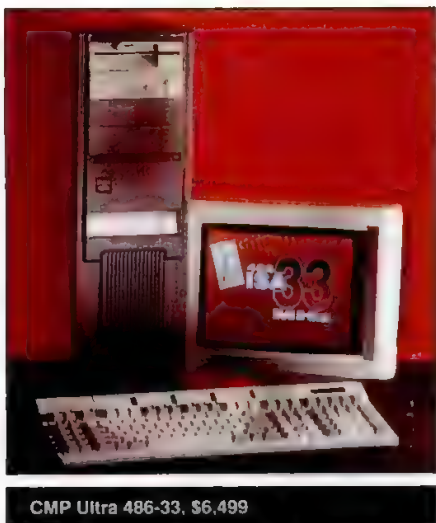
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CMP Ultra 486-33, \$6,499

Mitsumi floppy disk drive in addition to the standard configuration's 1.2MB drive, a Rendition II 1,024-by-768 video adapter, a Seiko CM-1440 Super VGA monitor, a 130-key Focus keyboard (which includes a calculator and diagonal-cursor-movement keys), and a special 220-watt PC Power and Cooling uninterruptible power supply, good for 7 to 10 minutes of use after the lights go out. Even with these fancy extras, the system costs only \$6,499.

The Ultra 486-33's case measures 25.5 by 7.5 by 17.3 inches; once the base support is installed, the width at the bottom is 9.5 inches. The case can hold six half-height drives. All switches—power, re-

COVER STORY 33-MHz 486 PCs

set, and turbo—are on the front of the chassis, as are a turbo indicator and keyboard lock. Only a mechanical case lock is missing.

The Ultra 486-33 uses a Cache Computers motherboard, which incorporates the Opti 486 chip set and the BAT BIOS. Besides offering built-in password protection, the BAT BIOS supports system and video BIOS shadowing; you can disable either of those through setup. The chip set takes charge of the external 128K processor RAM cache, which is made up of 25-nanosecond static-RAM DIP chips. The motherboard does not have a socket

The Ultra 486-33 is backed by better-than-average service and support policies.

for a Weitek math coprocessor.

All system memory in the Ultra 486-33 fits in SIMM sockets on the motherboard, with a system maximum of 16MB; the 1MB SIMMs in our evaluation unit were rated at 70 ns. The expansion slots, one 8-bit and seven 16-bit, are used for interface cards; in the tested system five slots were unused after the drive interface, I/O, and video cards were installed.

The Ultra 486-33's scores on PC Magazine Labs' benchmark tests were average for the most part. The machine stumbled on our video tests, yielding times that were among the slowest of the group. This is partly because the Rendition video board requires you to load a RAM-resident utility to produce faster results, and that is not done in our testing process.

The Ultra 486-33 is a Class A-certified machine, backed by service and support policies that are better than average, even when compared with those of the best mail-order companies. For one thing, Computer Market Place offers a 45-day money-back guarantee, which gives you more time than usual to assess the system. For another, an 18-month warranty covers the motherboard, and a one-year parts-and-labor warranty covers the rest of the system. On-site service is provided by

FACT FILE

Ultra 486-33

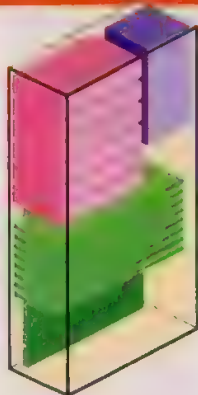
Computer Market Place Inc., 450 Parkway, #202, Broomall, PA 19008; 800-545-7397, 215-359-0750

List Price: With 2MB RAM, 128K RAM cache, 1.2MB floppy disk drive, Hercules-compatible monochrome display subsystem, one parallel and two serial ports, one game port, DOS 3.3 or 4.01, \$3,334; with 8MB RAM, 211MB hard disk, Super VGA color display subsystem, \$4,628; with 1.2MB and 1.44MB floppy disk drives, 1MB 1,024-by-768 video adapter, Seiko Super VGA color monitor, Focus 130-key keyboard with calculator, 220 watt-power supply with UPS, \$6,499.

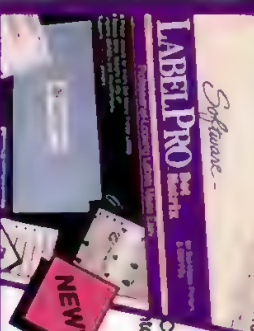
In Short: The Ultra 486-33 mail-order system comes at a great price and is backed by on-site service and a 45-day money-back guarantee. Decent expansion and average performance clinch the deal.

In Short: The Ultra 486-33 mail-order system comes at a great price and is backed by on-site service and a 45-day money-back guarantee. Decent expansion and average performance clinch the deal.

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DIAMOND TECHNOLOGIES

Diamond 486-33

by Bruce Brown

Diamond Technologies prices its Diamond 486-33 very competitively: \$4,999 for *PC Magazine's* standard configuration, including 8MB of RAM, a 128K processor RAM cache, a 16-millisecond 200MB Conner IDE hard disk, a 1.2MB YE Data floppy disk drive, an Orchid Pro Designer II Super VGA video adapter with 1MB of video RAM, a TVM SuperSync Super VGA monitor, one parallel and two serial ports, a game port, a 101-key Maxi-Switch keyboard, and DOS 4.01. Whether that price retains all its attractiveness in the light of the mail-order company's somewhat sparse service and support policies depends on how comfortable you feel going it alone or buying a service contract from another source.

If you decide to start small, Diamond Technologies still offers one of the best prices we've seen for a system based on the AMI Voyager motherboard. In its

COVER STORY

33-MHz 486 PCs

basic configuration, the Diamond 486-33 costs \$3,499 and comes with 4MB of RAM, the 128K cache, a 1.2MB or 1.44MB floppy disk drive, a 101-key keyboard, and the same number of ports as above. The system we tested differed from our standard configuration in that it had a 14-ms. 360MB Seagate hard disk with an UltraStor floppy/hard disk controller and a second (1.44MB) floppy disk



Diamond 486-33, \$5,499

drive, which brought the system price up to \$5,499.

The Diamond 486-33's familiar tower-style case measures 25.5 by 7.5 by 17.5 inches; adding a base to the bottom of the chassis increases the width of the footprint to 9.5 inches. The case has room for six half-height drives; it also includes a 220-watt power supply with six power leads. The power switch and the reset and turbo buttons are on the front of the chassis, as are the turbo indicator and electronic keyboard lock. There is no mechanical case lock.

The machine's AMI Voyager motherboard uses a Chips and Technologies chip set and an AMI BIOS, and it has a socket for a 33-MHz Weitek 4167 math coprocessor. System BIOS is shadowed in RAM all the time, but you can enable or disable video BIOS shadowing through the CMOS setup program. You can set the processor to run at 8, 20, 25, and 33.3 MHz; the bus runs from 7 and 9 MHz.

The Diamond 486-33's processor RAM cache is fixed at 128K and uses discrete logic. The 128K of static RAM in our tested unit used DIP chips rated at 25 nanoseconds.

As for system memory, the Diamond



BENCHMARK TESTS: 33-MHz 486-BASED PCs

Performance among the 486/33s is too close to call, varying by just 0.11 seconds from fastest to slowest on our 80486 Instruction Mix test. Don't look to external processor RAM cache for a dramatic difference in speed: The four noncached systems we reviewed (from Bitwise Designs, Novacor, Panther Systems, and PC Brand) fell within the normal performance range for PCs in this class.

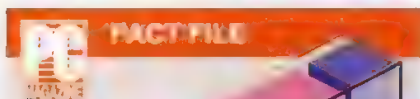
The **80486 Instruction Mix** benchmark test times a series of tasks specific to the 80486 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

PC Magazine Labs tested 30 33-MHz 486-based ISA computers for this issue. We ran the tests with video and system shadowing enabled, if possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed.



Diamond 486-33

Diamond Technologies, 17155 Von Karman Ave., #103, Irvine, CA 92714;

800-989-7253, 714-252-1008

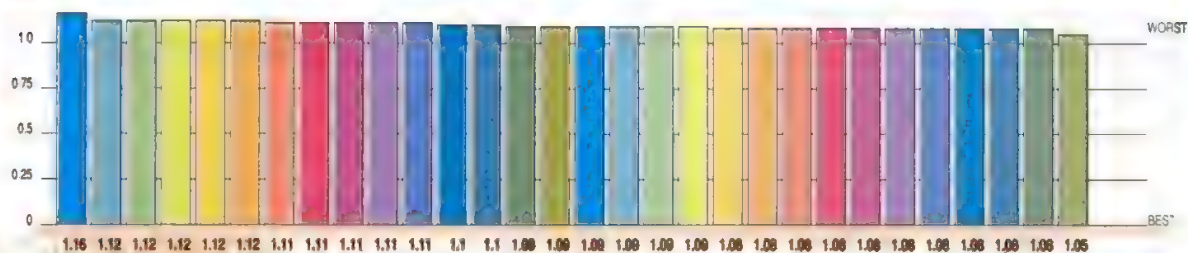
List Price: With 4MB RAM, 128K RAM cache, 1.2MB or 1.44MB floppy disk drive, one parallel and two serial ports, game port, \$3,499; with 8MB RAM, 200MB hard disk, Orchid ProDesigner II 1MB Super VGA video adapter, TVM SuperSync Super VGA color monitor, DOS 4.01, \$4,999; with 360MB hard disk, 1.2MB and 1.44MB floppy disk drives, \$5,499

In Short: This mail-order unit tested faster than average, and the price is very good. It holds up to 24MB and six drives. Though it comes with a 30-day money-back guarantee, the lack of on-site service—even as an option—and the absence of toll-free technical support are drawbacks.

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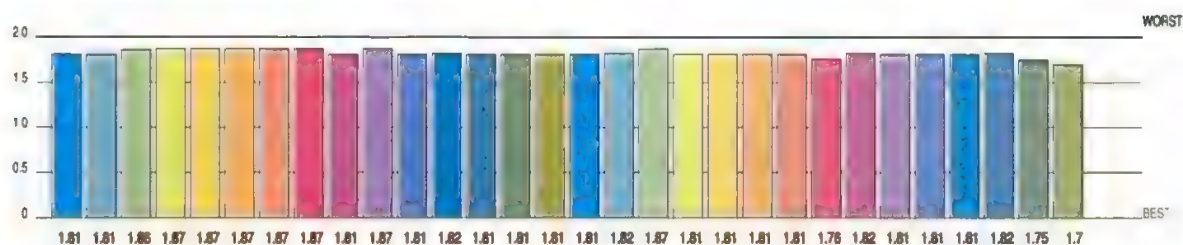
80486 Instruction Mix

Elapsed Time (seconds)



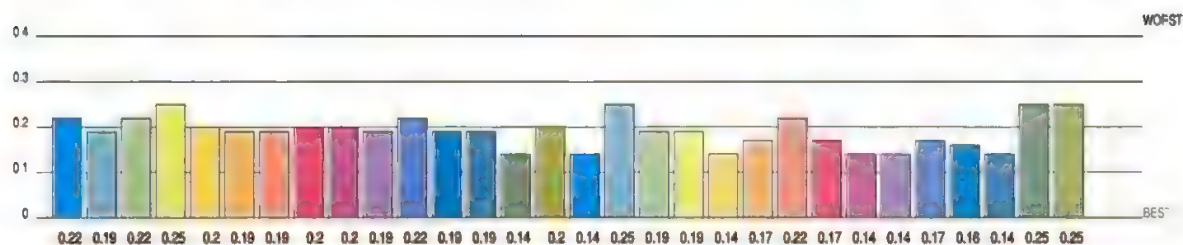
Floating-Point Calculation Without Coprocessor

Elapsed Time (seconds)



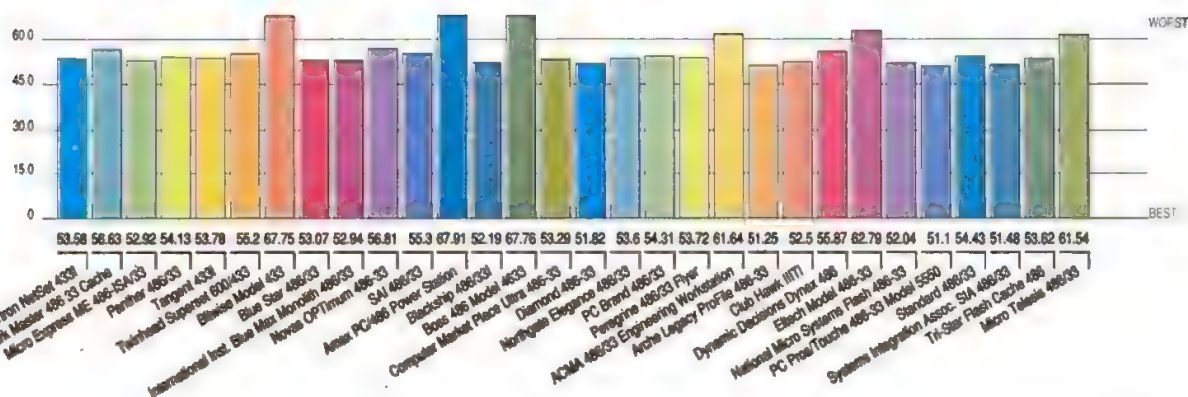
Conventional Memory

Elapsed Time (seconds)



DOS File Access (Small Records)

Elapsed Time (seconds)



CONTINUES



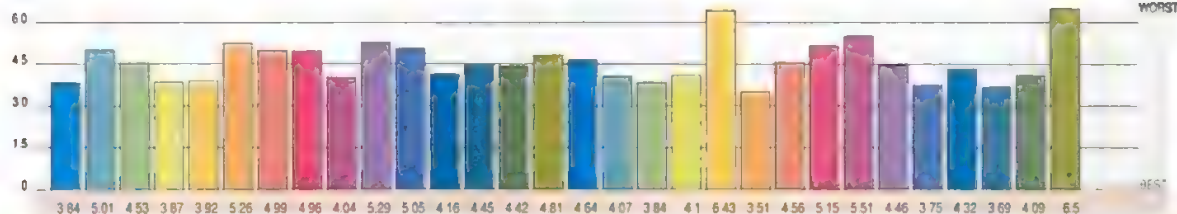
BENCHMARK TESTS: 33-MHz 486-BASED PCs

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

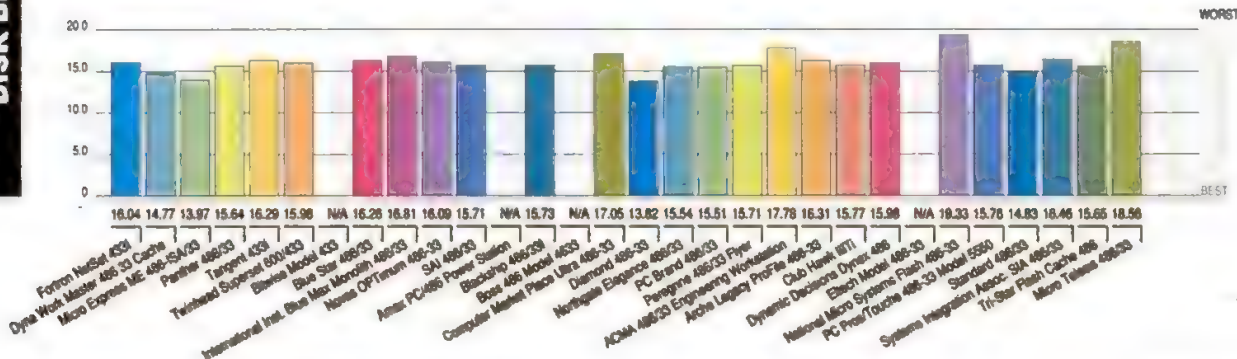
DOS File Access (Large Records)

Elapsed Time (seconds)



BIOS Disk Seek

Elapsed Time (milliseconds)



N/A—Not applicable: The product did not complete this test.

CONTINUES

486-33 can handle up to 24MB of fast page-mode RAM, with up to 8MB on the motherboard. In our tested unit, the 1MB SIMMs on the motherboard were rated at 60 nanoseconds. You can add 16MB of RAM with a \$149 memory board that fits in the machine's single 32-bit expansion slot. At the time of this review, Diamond was selling memory upgrades at \$100 per megabyte, a bit more than many other mail-order companies charge.

In addition to the 32-bit slot, which can also be used for 8-bit cards, the motherboard has one 8-bit and six 16-bit slots. Five slots were free in the test system after video, I/O, and drive controller cards were installed.

On PC Magazine Labs' benchmark tests, the Diamond 486-33 made a strong showing, tying with several other machines for first place on our Conventional Memory test and staying close to the lead-

ers on most of the other tests.

If Diamond's service and support policies matched the performance of its PC, the company might find itself dealing with more demand than supply. Included in the Diamond 486-33's purchase price is a 15-month parts-and-labor warranty. On-site service is not available, and the company does not have a toll-free technical support line. But Diamond will pay for shipping both ways during the first 30 days of ownership; after that time, Diamond pays for shipping only one way. In addition, the company offers a 30-day money-back guarantee.

With excellent performance, room for expansion, and a low price, the Diamond 486-33 is a good deal. If Diamond Technologies offered standard on-site service and a toll-free technical support line it would make the system even more attractive than it already is.

DYNAMIC DECISIONS INC.

Dynex 486

by Bruce Brown

Unless you purchase computers directly from value-added resellers (VARs), you probably will not be able to get your hands on the Dynex 486. That's because Dynamic Decisions sells its systems either through value-added resellers or directly to VARs' customers in a special co-sale arrangement.

The Dynex 486 is a fine system. In *PC Magazine's* standard configuration it costs \$7,405, including 8MB of RAM, a 128K processor RAM cache, a 16-millisecond 200MB Conner hard disk, a 1.2MB or 1.44MB TEAC floppy disk drive, an ATI Super VGA Wonder adapter with 512K of video RAM, a ViewPerfect3 Super



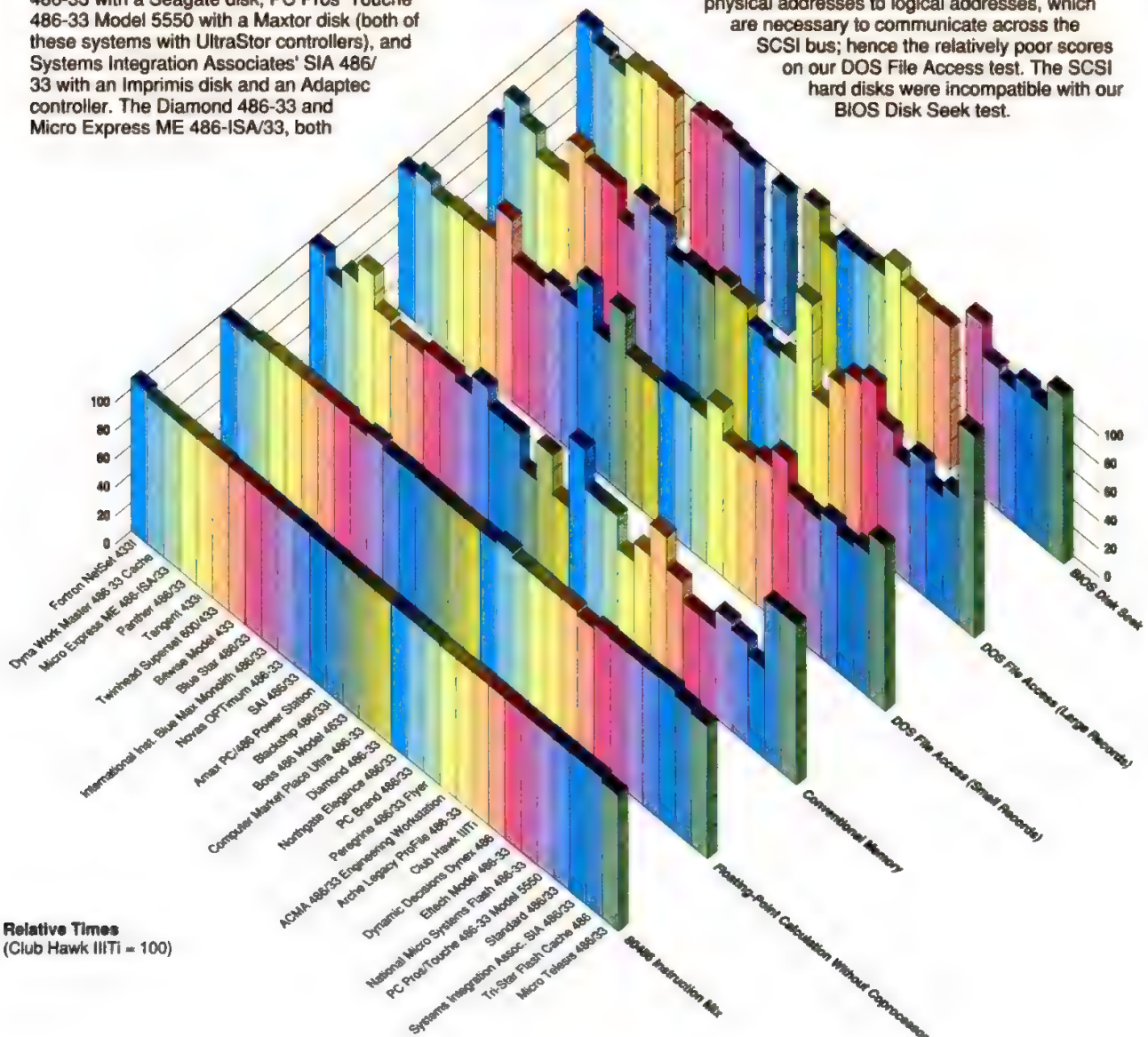
PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

Although the margins between the best and worst machines on our processor and memory benchmark tests were fairly slim, a couple of machines are conspicuous on both ends of the spectrum. Top honors go to Dynamic Decisions' Dynex 486, which took full advantage of its 60-ns. SIMMs in conventional memory and 128K of external processor RAM cache (discrete logic). The test results for the Panther 486/33, with no external RAM cache, were among the lowest two scores on all three tests—though there were many ties.

On our **DOS File Access** tests, three machines stood out, all using ESDI hard disks: the Arche Legacy ProFile 486-33 with a Seagate disk, PC Pros' Touche 486-33 Model 5550 with a Maxtor disk (both of these systems with UltraStor controllers), and Systems Integration Associates' SIA 486/33 with an Imprimis disk and an Adaptec controller. The Diamond 486-33 and Micro Express ME 486-ISA/33, both

with Seagate ESDI hard disks and UltraStor controllers, had notable BIOS Disk Seek times.

The disk tests were a stumbling block to the Micro Telesis 486/33 and ACMA 486/33 Engineering Workstation with their Rodime IDE hard disks. The four systems using SCSI drives also suffered: the Amax PC/486 Power Station, Bitwise Model 433, and Boss 486 Model 4633 (all with Maxtor drives and Adaptec controllers), and the Eltech Model 486-33 (with a Seagate hard disk and DTC controller). ISA-bus systems generate physical addresses to find information on the hard disk, and SCSI controllers incur an overhead in translating these physical addresses to logical addresses, which are necessary to communicate across the SCSI bus; hence the relatively poor scores on our DOS File Access test. The SCSI hard disks were incompatible with our BIOS Disk Seek test.



CONTINUES



FACT FILE

Dynex 486

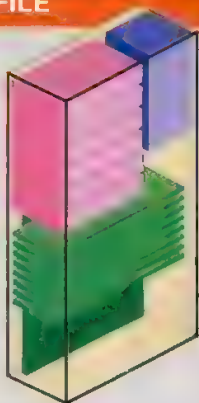
Dynamic Decisions Inc., 134 W. 26th St., 4th floor, New York, NY 10001; 212-242-0108.

List Price: With 4MB RAM, 128K RAM cache, 1.2MB floppy disk drive, VGA color display subsystem, \$5,995; with 8MB RAM, 200MB hard disk, 1.2MB or 1.44MB

floppy disk drive, 512K Super VGA video adapter, ViewPerfect3 Super VGA color monitor, one parallel and two serial ports, game port, DOS 4.01, \$7,405; with 1.2MB and 1.44MB floppy disk drives, \$7,495.

In Short: The Dynex 486 offers average performance and expansion room. It is sold only through VARs or by arrangement with VARs and the vendor, and its price remains high even with good discounts. The service and support policies are good.

CIRCLE 418 ON READER SERVICE CARD



VGA display with a maximum interlaced resolution of 1,024 by 768 pixels, one parallel and two serial ports, a game port, a 101-key Chicony keyboard with a 60-inch cable, and DOS 4.01. If you want a second floppy disk drive, this system will cost you \$7,495.

The Dynex 486's 25.5- by 7.5- by 17.5-inch tower case makes room for six half-height 5.25-inch drives and comes with a 230-watt Senstron power supply with four device connectors. Adding a base to the case widens its footprint by 2 inches. The power switch, reset and turbo buttons, turbo indicator, and electronic keyboard lock are on the front of the case.



Dynex 486, \$7,495

There is no mechanical case lock to be found on the system.

BASED ON VOYAGER

A Chips and Technologies 486 chip set and AMI BIOS are the backbone of the AMI Voyager motherboard. Other features of this well-respected motherboard are a fixed-size 128K processor RAM cache composed of 25-nanosecond static-RAM DIP chips, system and video BIOS shadowing (you can disable the video BIOS shadowing), and a socket for a 33-MHz Weitek 4167 math coprocessor.

The motherboard holds up to 8MB of RAM, which in our tested system was made up of 60-ns. 1MB SIMMs. If you need more memory, a \$295 memory expansion card can accept up to 16MB, bringing the system total to 24MB of 32-bit RAM. Dynamic Decisions currently sells memory upgrades for \$95 per megabyte.

If you do use the memory board, you'll seat it in the system's single 32-bit expansion slot; the slot also works with 8-bit boards. The motherboard contains one more 8-bit and six 16-bit slots. With video, drive interface, and I/O boards installed, the Dynex 486 system we tested had five free slots.

The Dynex 486's speedy performance on our memory and processor tests was in line with that of other machines based on AMI Voyager motherboards. Its times on our disk-intensive tests were about average, and its video times were a bit below average.

Dynamic Decisions' one-year warranty covers parts and labor except for the hard disk, which is covered for only nine months. In New York City you return the system to your VAR for warranty service; elsewhere, TRW on-site service is standard for the warranty period. The company has a toll-free technical support hotline and offers a 30-day money-back guarantee. The PC has a Class A FCC rating.

Buying the Dynex 486 is a relatively expensive way to get your hands on an AMI Voyager-based system; several other machines reviewed in this roundup are similarly equipped and sell for less than the list price of this system. Unless you and your value-added reseller can work out a discount or a software bundle, you may save some money by looking elsewhere.

DYNA MICRO INC.**Work Master 486 33 Cache**

by M. David Stone

You can regard the name of Dyna Micro's 33-MHz 486 entry, the Work Master 486 33 Cache, as a shorthand for some of the machine's features. What it doesn't tell you is that the machine is powered by a 250-watt PC Power and Cooling power supply with four device connectors; it has an UltraStor integrated controller that supports three floppy disk drives or two drives and a tape backup system, and is backed by a year of on-site service. All of these welcome elements help to justify the system's somewhat high list price.

In its basic configuration, the Work Master costs \$5,974 and includes 4MB of RAM, a 128K cache, a 1.2MB TEAC floppy disk drive, one parallel and two serial ports, a 101-key Honeywell keyboard, and DOS 4.01. Add 4MB of RAM, a 256K RAM cache, a 200MB Conner hard disk, an Orchid ProDesigner II Super VGA card with 512K RAM, and an ADI Super VGA monitor with a maximum noninterlaced resolution of 1,024 by 768 pixels, and you'll pay \$7,979 for the machine in *PC Magazine's* standard configuration. Upping the stakes once again,



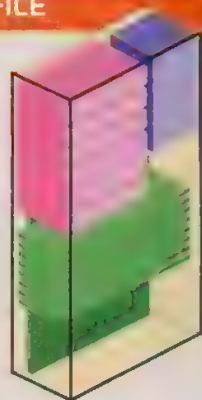
FACT FILE

Work Master 486 33 Cache

Dyna Micro Inc., 30 W. Montague Expwy., San Jose, CA 95134; 800-336-3962, 408-943-0100.

List Price: With 4MB RAM, 128K RAM cache, 1.2MB floppy disk drive, one parallel and two serial ports, DOS 4.01, \$5,974; with 8MB RAM, 256K RAM cache, 200MB hard disk, Super VGA color display subsystem, game port, \$7,979; with 320MB hard disk, two 1.2MB and one 1.44MB floppy disk drive, 1MB Super VGA video adapter, NEC MultiSync 4D color monitor, \$9,999.

In Short: The Work Master 486 33 Cache is worth its higher-than-average price. It includes plenty of small but useful extras, like a 250-watt power supply and a controller that supports two floppy disk drives and a tape backup. You won't find cut corners, but you will find intelligent design.



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CIRCLE 146 ON READER SERVICE CARD

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30MB 1:1 Interleave	\$3745	\$2795	\$2895	\$4045	\$4095	\$4145	\$4245		
60MB 1:1 Interleave	\$3795	\$2845	\$2945	\$4095	\$4145	\$4195	\$4295		
65MB 1:1 Interleave	\$3895	\$2945	\$3045	\$4195	\$4245	\$4295	\$4395		
80MB 1:1 Interleave	\$4195	\$4245	\$4345	\$4495	\$4545	\$4595	\$4695		
120MB 1:1 Interleave	\$4295	\$4345	\$4445	\$4595	\$4645	\$4695	\$4795		
160MB 1:1 Interleave	\$4695	\$4745	\$4845	\$4995	\$5045	\$5095	\$5195		
320MB 1:1 Interleave	\$5295	\$5345	\$5445	\$5595	\$5645	\$5695	\$5795		

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MICROLAB 386 Cache/25 Price Matrix	Monochrome 12 720x350	Monochrome Flat 16 720x350	CGA Color 14 640x350	EGA Color 14 640x350	VGA Color 14 640x480	VGA Multi 14 800x600	VGA Hi-Res 14 1024x768		
30MB 1:1 Interleave	\$2195	\$2245	\$2345	\$2495	\$2545	\$2595	\$2695		
60MB 1:1 Interleave	\$2245	\$2295	\$2395	\$2545	\$2595	\$2645	\$2745		
65MB 1:1 Interleave	\$2345	\$2395	\$2495	\$2645	\$2695	\$2745	\$2845		
80MB 1:1 Interleave	\$2645	\$2695	\$2795	\$2945	\$2995	\$3045	\$3145		
120MB 1:1 Interleave	\$2745	\$2795	\$2895	\$3045	\$3095	\$3145	\$3245		
160MB 1:1 Interleave	\$3145	\$3195	\$3295	\$3445	\$3495	\$3545	\$3645		
320MB 1:1 Interleave	\$3745	\$3795	\$3895	\$4045	\$4095	\$4145	\$4245		

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MICROLAB 386/25 Price Matrix	Monochrome 12 720x350	Monochrome Flat 16 720x350	CGA Color 14 640x350	EGA Color 14 640x350	VGA Color 14 640x480	VGA Multi 14 800x600	VGA Hi-Res 14 1024x768		
30MB 1:1 Interleave	\$1895	\$1745	\$1845	\$1995	\$2045	\$2095	\$2195		
60MB 1:1 Interleave	\$1745	\$1795	\$1895	\$2045	\$2095	\$2145	\$2245		
65MB 1:1 Interleave	\$1845	\$1895	\$1995	\$2145	\$2195	\$2245	\$2345		
80MB 1:1 Interleave	\$2145	\$2195	\$2295	\$2445	\$2495	\$2545	\$2645		
120MB 1:1 Interleave	\$2245	\$2295	\$2395	\$2545	\$2595	\$2645	\$2745		
160MB 1:1 Interleave	\$2645	\$2695	\$2795	\$2945	\$2995	\$3045	\$3145		
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40MB 1:1 Interleave	\$1395	\$1665	\$1565	\$1695	\$1745	\$1795	\$1895
65MB 1:1 Interleave	\$1495	\$1545	\$1645	\$1795	\$1845	\$1895	\$1995
80MB 1:1 Interleave	\$1795	\$1845	\$1945	\$2095	\$2145	\$2195	\$2295
120MB 1:1 Interleave	\$1895	\$1945	\$2045	\$2195	\$2245	\$2295	\$2395
160MB 1:1 Interleave	\$2295	\$2345	\$2445	\$2595	\$2645	\$2695	\$2795
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Price Matrix	12"	14"	14"	14"	14"	16"	16"
	720/350	720/350	640/200	640/350	640/480	800/600	1024/768
30MB 1:1 Interleave	\$1595	\$1645	\$1745	\$1895	\$1945	\$1995	\$2095
40MB 1:1 Interleave	\$1695	\$1745	\$1845	\$1995	\$2045	\$2095	\$2195
65MB 1:1 Interleave	\$1795	\$1845	\$1945	\$2095	\$2145	\$2195	\$2295
80MB 1:1 Interleave	\$1895	\$1945	\$2045	\$2195	\$2245	\$2295	\$2395
120MB 1:1 Interleave	\$1995	\$2045	\$2145	\$2295	\$2345	\$2395	\$2495
160MB 1:1 Interleave	\$2095	\$2145	\$2245	\$2395	\$2445	\$2495	\$2595
320MB 1:1 Interleave	\$2195	\$2245	\$2345	\$2495	\$2545	\$2595	\$2695

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Landmark: 16.1 - Norton: 13.4

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MICROLAB	Mon	Mon	CGA	EGA	VGA	VGA	VGA
XT 12	Chrome	Flat	Color	Color	Color	Multi	Hi Res
Price Matrix	12"	14"	14"	14"	14"	16"	16"
	720/350	720/350	640/200	640/350	640/480	800/600	1024/768
30MB 1:1 Hard Disk	\$745	\$795	\$895	\$1045	\$1095	\$1145	\$1245
40MB 1:1 Hard Disk	\$795	\$845	\$945	\$1095	\$1145	\$1195	\$1295
65MB 1:1 Hard Disk	\$895	\$945	\$1045	\$1195	\$1245	\$1295	\$1395
80MB 1:1 Hard Disk	\$1195	\$1245	\$1345	\$1495	\$1545	\$1595	\$1695
120MB 1:1 Hard Disk	\$1295	\$1345	\$1445	\$1595	\$1645	\$1695	\$1795

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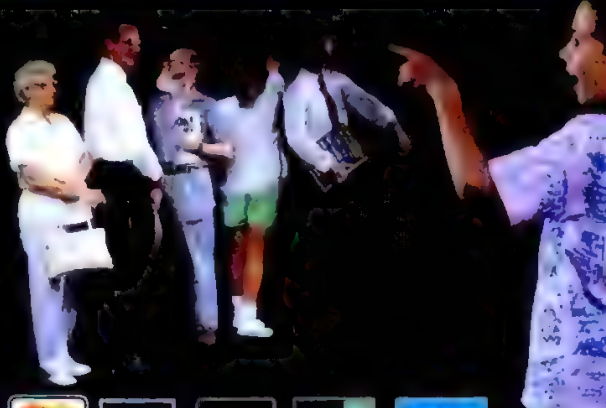
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BENCHMARK TESTS: 33-MHz 486-BASED PCs

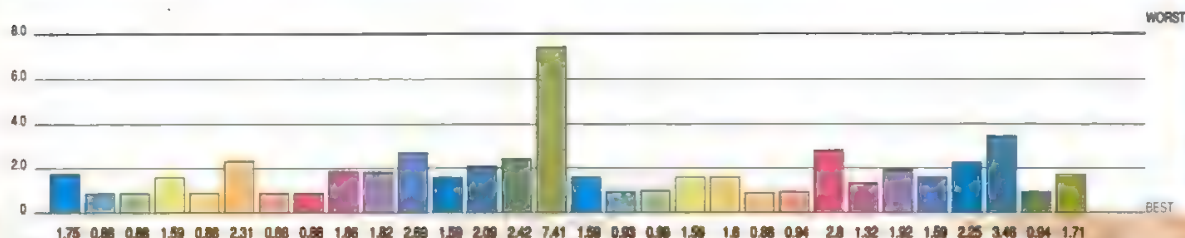
The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

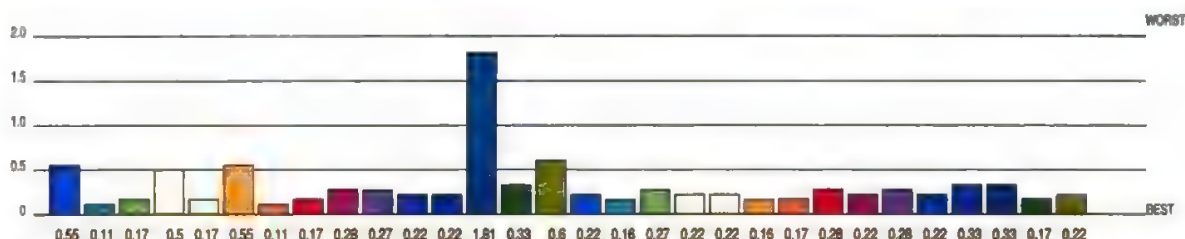
Direct to Screen

Elapsed Time (seconds)



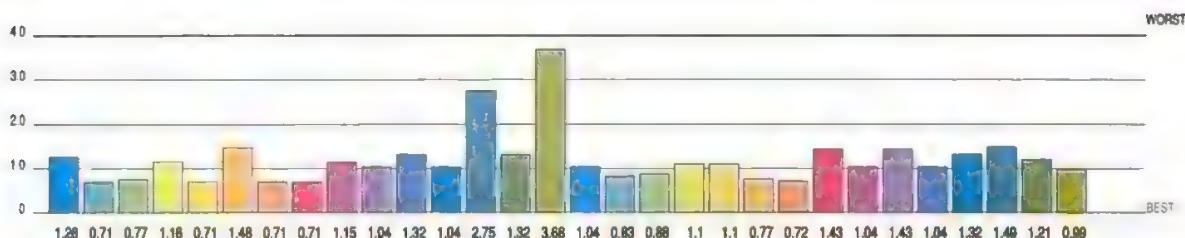
Video BIOS Routine Without Scrolling

Elapsed Time (seconds)



Video BIOS Routine with Scrolling

Elapsed Time (seconds)



our \$9,999 tested system came with a 320MB Seagate hard disk, three TEAC floppy disk drives (two 1.2MB and one 1.44MB drive), 1MB of RAM on the video card, and a NEC MultiSync 4D monitor.

The Work Master 486 33 Cache measures 24.3 by 7.3 by 16.5 inches, and it comes with the usual reset and turbo buttons and power switch on the front panel. Inside the tower case you'll find six half-height drive bays in a single stack, which

should provide enough storage space for most purposes.

The Work Master's AIR motherboard uses a combination of standard components and proprietary discrete logic. In addition to the 80486/33, you'll find an AMI BIOS, a socket for a 33-MHz Weitek 4167 math coprocessor, and one chip from the Chips and Technologies chip set. The AMI BIOS supports video and system BIOS shadowing, both of which can be quickly disabled through the setup string.

You can set the processor to run at either 8 or 33 MHz.

Also on the tested unit's motherboard was the 256K static-RAM cache; it too is controlled by discrete logic. According to Dyna Micro, the cache normally uses 25-nanosecond chips, but the chips in the tested unit were rated at 30 ns.

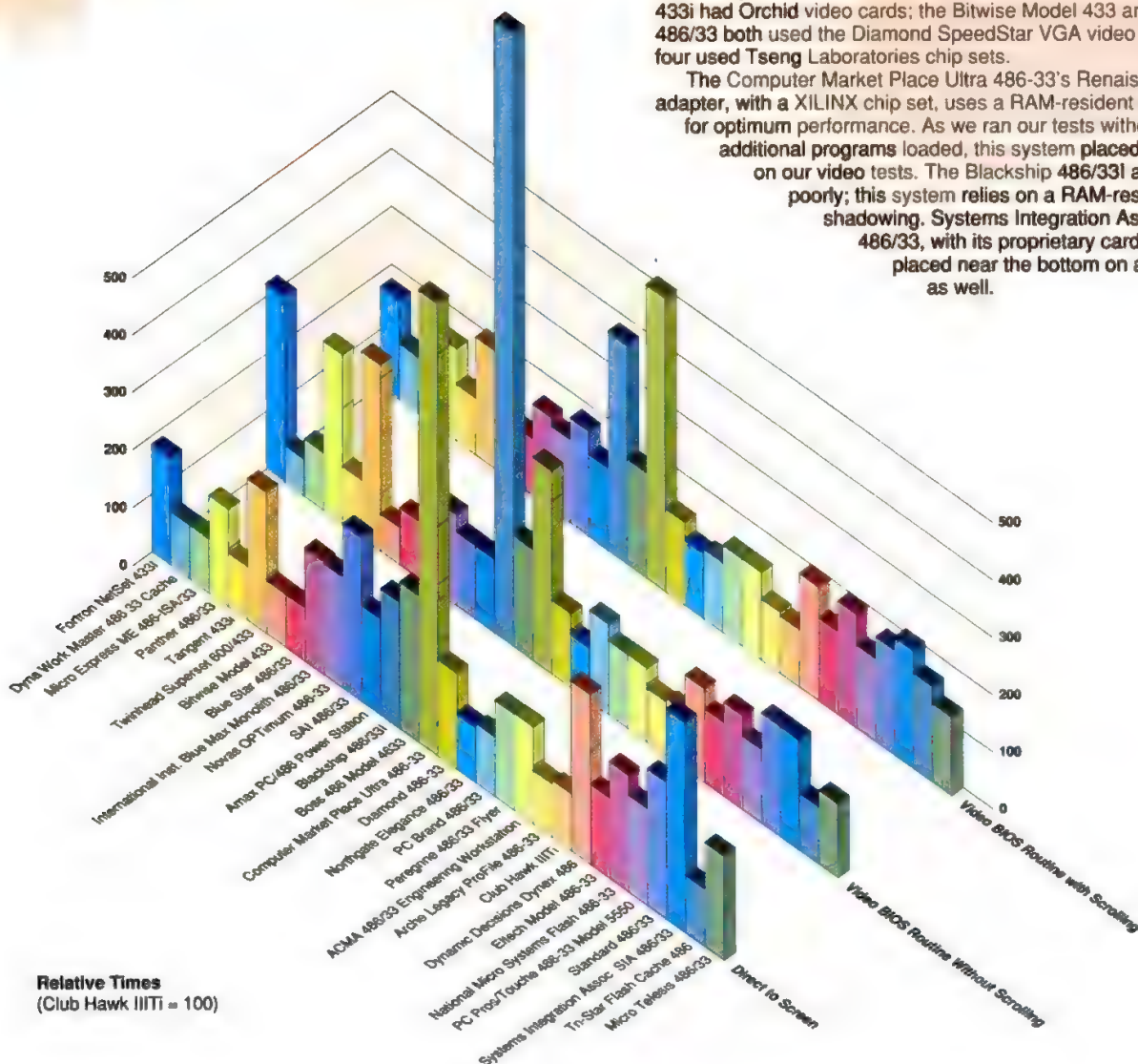
The AIR motherboard includes 16 SIMM sockets, so you can install the system maximum of 16MB of RAM without having to use an expansion slot; this is



VIDEO BENCHMARK TESTS: COMPOSITE VIEW

Top performers on our video tests relied on cards we have seen before. Dyna Micro's Work Master 486 33 Cache and the Tangent 433i had Orchid video cards; the Bitwise Model 433 and Blue Star 486/33 both used the Diamond SpeedStar VGA video adapter. All four used Tseng Laboratories chip sets.

The Computer Market Place Ultra 486-33's Renaissance video adapter, with a XILINX chip set, uses a RAM-resident setup utility for optimum performance. As we ran our tests without any additional programs loaded, this system placed at the bottom on our video tests. The Blackship 486/33i also performed poorly; this system relies on a RAM-resident utility for shadowing. Systems Integration Associates' SIA 486/33, with its proprietary card and chip set, placed near the bottom on all three tests as well.



ENDS

an example of intelligent design. In the tested unit, eight sockets were filled with 1MB modules rated at 70 ns. The sockets are situated between the system slots and the power supply, where they are easy to reach if you need to add or change SIMMs.

In another smart move, Dyna Micro made all eight system slots 16-bit, so you can put any card in any slot. In our tested unit, three slots were filled by a video card, an UltraStor ESDI controller, and a parallel/serial card. Two more slots were

blocked by the game port and the second serial port, but you can free those slots by specifying connectors that mount in the cutouts on the back panel. If you buy the Work Master, be sure to order it that way from the company.

The Work Master's 128K or 256K cache may not buy you an increase in performance: According to Dyna Micro, the additional cache (beyond the 8K in the 486 chip) will make a difference under Unix but not under DOS. Indeed, PC

Magazine Labs' processor and memory benchmark tests showed little difference among 33-MHz 486 systems, regardless of cache size. On most other tests, the Work Master's performance was just about average. But its video times were the fastest of the entire group, giving the machine better-than-average speed overall. The system has an FCC Class A certification.

All told, the Work Master 486 33 Cache offers fair value for the price. You can



Work Master 486 33 Cache, \$9,999

easily find equal performance for less money, but you may wind up with a system that cuts corners. If you appreciate intelligent design, you'll appreciate this Dyna Micro computer.

ELTECH RESEARCH INC.**Eltech Model 486-33**

by Bill O'Brien

More often than not, impressive new computer technology arrives in impressive (tower-size) packaging. Not so with the Eltech Model 486-33, from Eltech Research. It's boxed in a 6.8- by 21- by 16.3-inch desktop case that carries an equally unassuming \$5,559 price tag for our standard configuration. That includes 8MB of RAM, a 300MB hard disk, dual floppy disk drives, a Super VGA color display subsystem, DOS 4.01, *Microsoft Windows 3.0*, *QAPLus*, and a *Microsoft Mouse*.



Eltech Model 486-33, \$5,559

The case is a classic AT design, with three half-height bays accessible through the front panel and two additional half-height bays under the panel and to the left of the first three. The power switch is on the right side of the case, while the turbo and reset buttons (and their appropriate LEDs) adorn the front. Eltech has included a 200-watt SkyNet power supply,

and although it is not a high-wattage dynamo, it should adequately minister to the system's needs.

An AMI Voyager motherboard powers the Model 486-33. This motherboard has system BIOS shadowing always enabled to enhance performance (video BIOS shadowing can be set through the standard CMOS setup routine). The Voyager is awash with discrete components in place of a large-scale integrated

**EDITORS' CHOICE**

- Club Hawk IIITi
- Northgate Elegance 486/33

If you're ready for the power and speed of 486/33s, you'll want the kind of quality and expandability that the Club Hawk IIITi and Northgate Elegance 486/33 offer.

In *PC Magazine's* standard configuration, these computers come with 8MB of RAM, an external RAM cache, a hard disk with room for at least 200MB of storage, at least one high-density floppy disk drive, a Super VGA color display subsystem, one parallel and two serial ports, and DOS 4.01.

The \$6,100 Club Hawk IIITi, from Club American Technologies, is an ideal file server at a reasonable price. The system's case is outstanding, with separate keyboard and case locks for extra security. Inside, nine half-height drive bays include five that can handle removable media. At this price, you'll also get a 338MB hard disk. While the board has eight slots—an average number—discrete logic handles the video and disk controller functions, giving the system the kind of expandability this category demands.

Northgate Computer Systems won Editors' Choice for its Elegance 486/25 (*PC Magazine*, September 11, 1990), and its latest candidate proves to be an equally good choice among 486/33s. In its most basic configuration, the Northgate Elegance 486/33 comes bundled with DOS 4.01, *Microsoft Windows 3.01* and a *Microsoft Mouse*. Samna Corp.'s word processing program *Ami Professional*, and Informix Software's spreadsheet program *Wingz*, came bundled in our test system. Clearly,

Northgate has made ease of use (and the graphical interface) a priority. Superfast video benchmark test scores reinforce this strategy.

Like many of our Editors' Choice winners, Northgate offers service and support policies that should make owning this system an easy experience. A one-year warranty, toll-free technical support, and on-site service are all part of the package. While not the lowest-priced machine in the group, the Northgate Elegance 486/33 is well worth \$7,195 in our standard configuration. At that price, you'll get the extra software and both 1.2MB and 1.44MB floppy disk drives as well.

Several other 486/33s are also worth exploring. Systems Integration Associates' SIA 486/33 receives honorable mention for its exceptional expandability, offering room for as many as ten half-height drives in a well-constructed tower case. In *PC Magazine's* standard test configuration, including a 322MB Imprimis hard disk, this system carries a list price of \$10,555. You will probably be able to get substantial discounts, however, as the system is sold through dealers.

If you need a 486/33 for less than \$5,000, think about these two machines: National Micro Systems' Flash 486-33 and Diamond Technologies' Diamond 486-33. Each sells for \$4,999 in our standard configuration and offers fine performance, though the Flash 486/33 offers the versatility of eight drive bays, compared with the six to be found in the Diamond's tower case.

Choose 1 of these 3 sets for only \$4.95

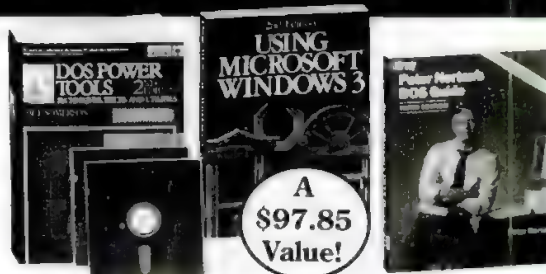
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1-2-3 User's Set

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PC Magazine 2/91

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THE HOROSCOPE REPORT OF THE WEEKS
VOL. 6, NO. 4, FALL 1990

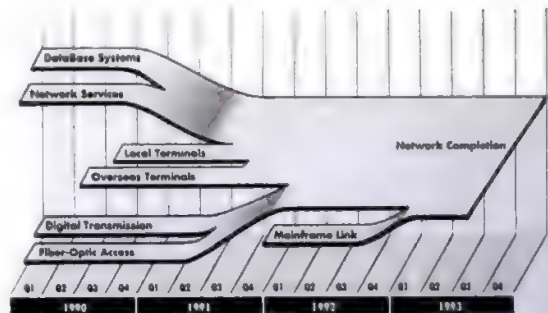
STAR SHORTS
Reported by The Star
Every day billions of star particles enter Earth's atmosphere. How scientists are working to make them visible.

How Can't See the Great Wall from the Moon?
Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to an astronaut, it's still out even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects: the planet's south pole.

NO BLACK HOLES?
Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tapping down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

MIRROR, MIRROR
It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the telescope

LONGUST NETWORK INTEGRATION PROJECT



CHAIN REACTION

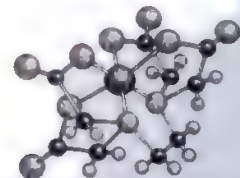
SCIENCE'S CHEMICAL LETTERS

NEW LANGE TO MATCH FARGAN'S CHEMISTRY

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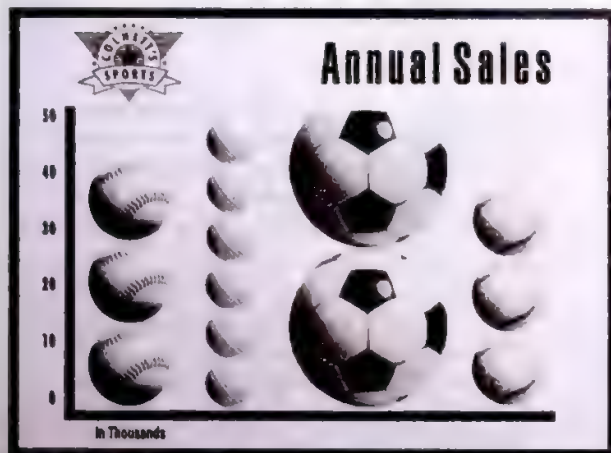


Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It has led to unique new products for a range of applications: catalysts, pigments, polymers, and more. It is a field of rapid growth and discovery, and this special issue is a testament to its importance.

It was almost exactly 50 years ago that a new material was discovered. It was called 'polymer' and it was the beginning of a new era in chemistry. The discovery of polymers has led to many of the materials we use today, from plastics to fibers to medicines.

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There's a lot to like. Like two paper trays for different types and sizes of paper. 200-sheet

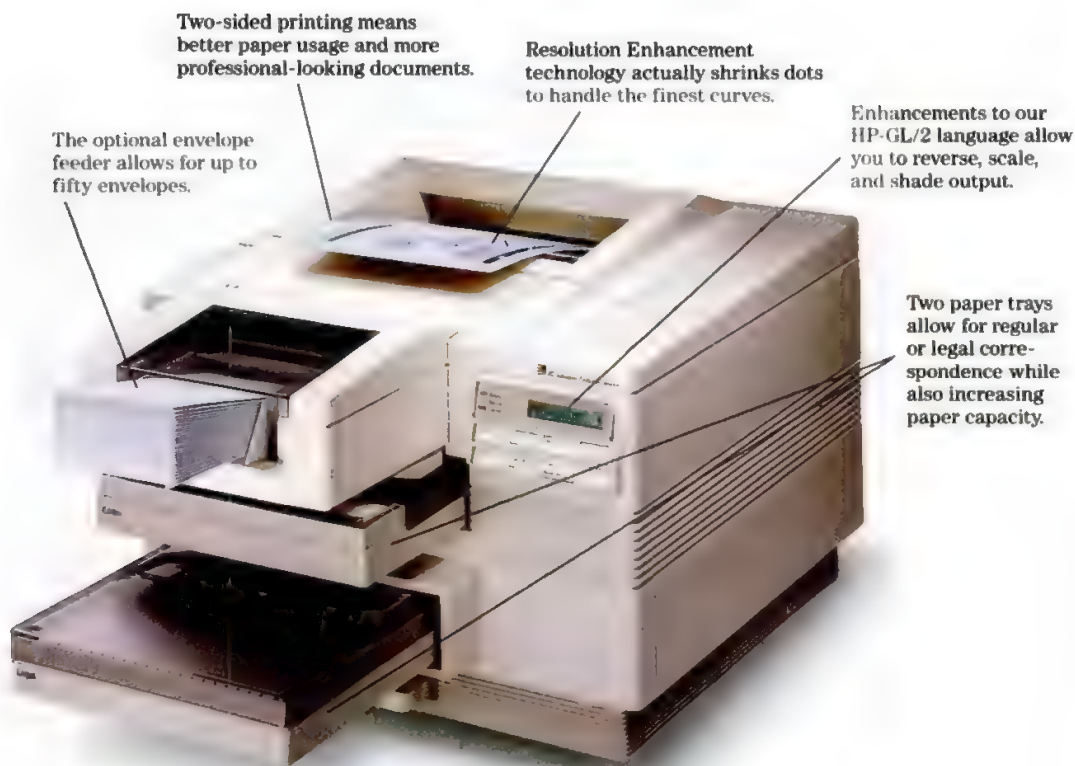
capacity in each of those trays for less reloading. And two-sided printing that lets you easily condense your output. Even an optional automatic envelope feeder that eliminates manual feeding.

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you'll automatically like the new HP LaserJet IIID.



hanced PCL5 printer language, which includes HP-GL/2 graphics language. You can print regular or reverse type. Shaded text. Even portrait and landscape on the same page.

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The best part is that the \$2,395* LaserJet III and \$3,595* LaserJet IIID are both easily within any budget. So call 1-800-752-0900, Ext. 1586. We'll tell you where to find your nearest authorized HP dealer.



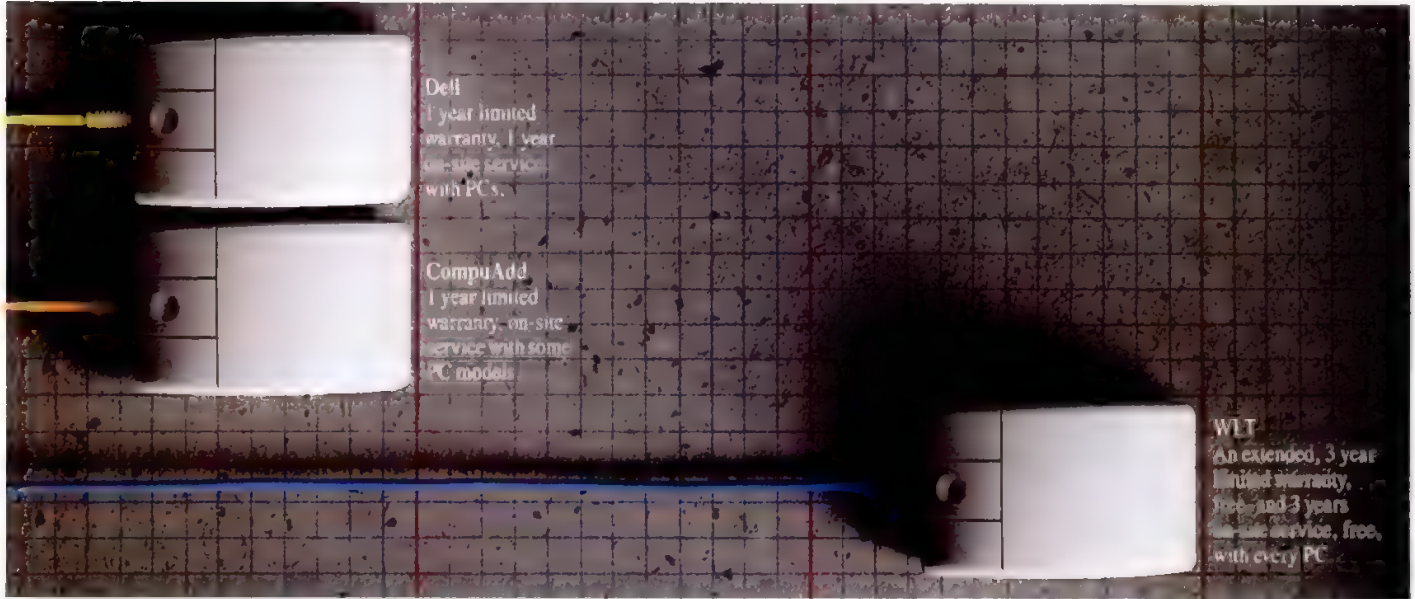
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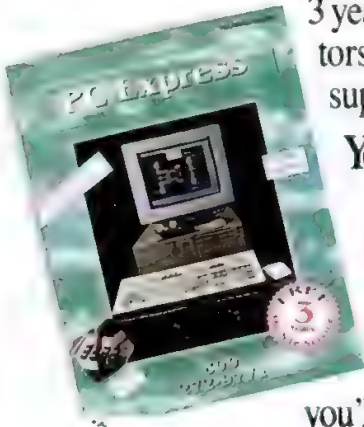
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DOVER STORY

33-MHz 486 PCs



FACT FILE

Eltech Model 486-33

Eltech Research Inc., 47266 Benicia St., Fremont, CA 94538; 415-438-0990 (sales), 415-438-0301 (service).
List Price: With 4MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, Super VGA monochrome display subsystem, one parallel and two serial ports, DOS 4.01, \$4,199; with 8MB RAM, 300MB hard disk, Super VGA color display subsystem, Microsoft Windows 3.0, QAPLUS, Microsoft Mouse, \$5,559.
In Short: Without the incentives of on-site service and a 60-day return policy, the Eltech Model 486-33 would be lost in a small crowd. With those options, however, it may be the cause of a small crowd.

CIRCLE 420 ON READER SERVICE CARD

processor chip set and cache controller. On our tested unit, it was populated with 8MB of 80-nanosecond RAM coupled with 128K of 25-ns. cache static RAM; the union of the two put the Eltech Model 486-33 on an equal footing with the other machines on PC Magazine Labs' benchmark tests.

The maximum motherboard RAM capacity is 8MB, but a proprietary slot can accommodate a memory expansion card that will boost the system to its total 24MB. Along with the proprietary memory slot are two 8-bit and six 16-bit slots. Five of the eight remain open after video, disk controller, and I/O boards are in place.

Our tested unit's mammoth 300MB Seagate SCSI hard disk was attached to a DTC SCSI controller, but the pair failed to make a good impression on our large- or small-record DOS File Access tests. It would be unfair to categorize the drive as slow, but its performance was somewhat below average. (Eltech does offer an ESDI drive of comparable size.) The Diamond SpeedStar Super VGA board fared better when matched against the other systems' scores on our Direct to Screen and Video BIOS Routine benchmark tests. While it didn't demonstrate top-rung performance, it did place above the average.

A plethora of documentation arrived with the Model 486-33. Unfortunately, not much of it was of any use. QAPLUS, a quality-assurance program from DiagSoft, is included with the system. Its excellent 130-page manual takes you step by step through the program, but of course, this wasn't designed to help with any of the

basic system questions that typically occur to first-time users. Likewise, the 69-page Diamond SpeedStar manual is quite good in dealing with the setup and driver possibilities of the video board, but it goes no further than that.

Offsetting this lack of printed matter is Eltech's toll-free support line. You can contact live support technicians from 7:00 to 7:00 P.S.T.; after business hours, you can leave your message with an answering machine.

Eltech does provide a rather lengthy trial period as well, giving you 60 days to evaluate the computer's performance. If you decide not to keep it, Eltech will pay the return shipping. Keep the computer and you're covered for a year on all parts and labor through a telephone system for troubleshooting and parts swapping, with Intel providing on-site service during the warranty period. Eltech claims a 48-hour turnaround for problems.

With several other computers selling in a similar price bracket and offering equivalent performance, making your choice can be difficult. What makes the Eltech stand out as a good buy is its on-site service, good support, and generous 60-day return policy.

FORTRON/SOURCE

Fortron NetSet 433I

by M. David Stone

Disguised in an AT-style case, Fortron/Source's NetSet 433I can masquerade as just another desktop computer. However, a look inside tells another story. The NetSet



Fortron NetSet 433I. \$5,495



FACT FILE

Fortron NetSet 433I

Fortron/Source, 6818G Patterson Pass Rd., Livermore, CA 94550; 800-821-9771, 415-373-1008.
List Price: With 4MB RAM, 64K RAM cache, 1.2MB or 1.44MB floppy disk drive, one parallel and two serial ports, Super VGA color display subsystem, DOS 4.01, PC-Kwik, \$3,895; with 8MB RAM, 207MB hard disk, 1.2MB floppy disk drive, \$5,495.
In Short: Given its low-end price, the Fortron NetSet 433I's midrange performance stands out favorably—especially since that price includes extras such as better-than-average expansion capabilities and one year of on-site service.

CIRCLE 421 ON READER SERVICE CARD

433I offers some high-end components, delivers midrange 33-MHz 486 performance, and sells at a low-end price, as well.

For a standard-configuration price of \$5,495—less expensive than most of the 25-MHz 486 systems we reviewed last year (*PC Magazine*, September 11, 1990)—you get 8MB of RAM, a 64K RAM cache, a 207MB Maxtor hard disk, a 1.2MB TEAC floppy disk drive, Fortron's own Super VGA card, an AOC monitor, one parallel and two serial ports, a 101-key NMB Technologies keyboard, and DOS 4.01. Both the card and the monitor are 8514-compatible, offering a maximum interlaced resolution of 1,024 by 768 pixels. Also included is one year of on-site service from GE Computer Services. If that price is out of your budget, you can buy the NetSet 433I in a basic configuration with 4MB of RAM and no hard disk for \$3,895.

On the front panel of the NetSet 433I's 6.5- by 21- by 16-inch case are the usual reset switch and keyboard lock. The system does not have a turbo switch; instead, you activate turbo mode by a keyboard command. The desktop chassis accommodates the standard drive bay arrangement: five half-height bays arranged in stacks of three and two. Three bays are accessible through the front of the computer's case.

The Fortron/Source NetSet 433I's motherboard is built by AMI but bears a Fortron label. In addition to the 80486/33 microprocessor, the motherboard features an AMI BIOS, a Chips and Technologies chip set, a socket for a Weitek 4167 math

coprocessor, a 64K cache of 15-nano-second static RAM, and discrete logic serving as a cache controller.

The NetSet 433I's RAM options are somewhat complicated. The motherboard has sockets for both DIP chips and SIMMs, and it can take either or both in various combinations. As tested, the system had 4MB of DIP RAM and 4MB of SIMM RAM, all of which took the form of 70-ns. chips. If you need more than 8MB, the system will also support 4MB SIMMs in its four SIMM sockets, yielding a maximum 16MB on the motherboard. In addition, Fortron/Source sells a RAM card with 16 SIMM sockets. The card will support only 1MB SIMMs, giving the NetSet 433I a maximum system memory of 32MB.

The system's memory card plugs into a 32-bit expansion slot, which can also function as an 8-bit slot. Also located on the motherboard are six 16-bit slots and one 8-bit slot, for a fairly typical total of eight slots. In our tested unit, only two slots were filled—with a Fortron video card and a Fortron combination I/O card, IDE connector, and floppy disk drive controller—leaving plenty of room for expansion.

The NetSet 433I's performance on PC Magazine Labs' benchmark tests was generally midrange. On our processor and memory tests, which didn't show much difference between the best and worst systems, its performance ranged from among the fastest to among the slowest.

The machine's times in our video tests were generally about or just below average. And its scores on our disk-intensive tests were marginally above average—approximately the same as those of Fortron's 33-MHz 386 system, the NetSet 333, which we reviewed last year (*PC Magazine*, December 25, 1990). For disk-intensive applications, the NetSet 433I may not be any faster than its 386 counterpart.

Certainly the best feature of the Fortron/Source NetSet 433I (with its FCC Class A certification) is the price. And in a race with little performance difference among the contenders, choosing a system based on price is certainly defensible. When you also consider that the price of the NetSet 433I includes one year of on-site service and a one-year parts-and-labor warranty, and that the system proffers better-than-average expansion possibilities, the case for this computer only gets stronger.

INTERNATIONAL INSTRUMENTATION INC.

Blue Max Monolith 486/33

by Bill O'Brien

Two things will surprise you about International Instrumentation's Blue Max Monolith 486/33. The first is that it's not blue. The second is that it's a desktop computer, not the tower its monolith moniker might suggest. The price, however, is more shocking than surprising when compared with much of the competition: A system equipped to meet our standard configuration—with 8MB of RAM, a 128K processor RAM cache, a 300MB ESDI hard disk, dual high-density floppy disk drives, a Super VGA display subsystem, two parallel and one serial port, and DOS 4.01—costs \$8,726.

I's favored configuration for this unit includes 4MB of RAM, the same hard disk, and a single floppy disk drive, but with a caching disk controller packed with 1MB of RAM. At that level, the system price rises to \$8,997. You can save a full \$1,000, however, if you switch back to the buffered ESDI controller that was sent along with the machine we reviewed (hence the lower list price for our tested configuration, even though it has 4MB more RAM).

The case is straight from the AT chassis design book, with three half-height bays

accessible through the front panel and two adjacent half-height bays located under the panel. The power switch is on the right side of the case, while the turbo and reset buttons (and their appropriate LEDs) grace the front. The company has opted to include a 230-watt Senstron power supply that should amply meet all the system's needs.

The Blue Max contains an AMI Voyager motherboard that uses a plethora of discrete components instead of the large-scale integrated devices sometimes used as the processor chip set and cache controller. In our tested unit, 8MB of 70-nanosecond RAM filled all of the available SIMM slots on the motherboard, with expansion beyond that allocated to a proprietary memory slot. The motherboard exceeds the typical 16MB memory maximum by permitting 16MB on the expansion card, thus increasing the RAM capacity to 24MB.

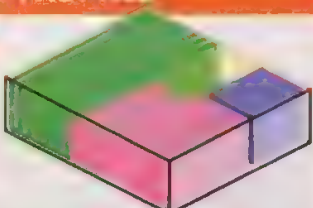
Aside from the single proprietary memory slot, there are two 8-bit and six 16-bit slots. Five of the eight slots remain available after the video, disk controller, and I/O boards are inserted.

System BIOS shadowing is always enabled on AMI Voyager boards, while video BIOS shadowing can be set through the standard CMOS setup routine. Also assisting the computer's talents is the 128K of 25-ns. cache SRAM. The Blue Max's performance on PC Magazine Labs' 80486 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests proved to be average, but remember that in this arena the reviewed systems' scores on these tests generally fall within a small range.

The hard disk of choice is a CMI 300MB ESDI unit that's Novell-certified, as clearly stated on its label. In this system, it was coupled to an Adaptec ESDI controller with 32K of buffering RAM; as usual, our large- and small-record DOS File Access tests overwhelmed the controller's small buffer. Despite that, the drive managed to achieve test scores that placed it above average. Likewise, the combination of a Headland Super VGA card and Sony 1304 monitor proved not only good to look at but also slightly faster than average on our video tests.

A single spiral-bound booklet offers nearly 200 pages of documentation, including the AMI Voyager technical manual. This technical information covers more than two-thirds of the documentation, but the remaining bits adequately

FACT FILE



Blue Max Monolith 486/33
International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361; 805-495-7673.
List Price: With 4MB RAM, 128K RAM cache, 300MB hard disk, 1.2MB floppy disk drive, Super VGA color display subsystem, two parallel and one serial port, \$7,997; with 8MB RAM, 1.2MB and 1.44MB floppy disk drives, DOS 4.01, \$8,726.
In Short: Neither blue nor towering, the Blue Max Monolith 486/33 offers expandability to 24MB RAM and plenty of storage space in its 6.5- by 21- by 16-inch case. No on-site service is available.

CIRCLE 422 ON READER SERVICE CARD

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Yet, the greatest praise of all comes from the *Software Digest*

Ratings Report dated August 1990, which for the second consecutive year



evaluates Freelance as the top rated presentation graphics program. Freelance 3.01 out scores Harvard 2.3 on many counts, including quality of output, printing speed and overall product quality. Freelance was also rated more powerful than Harvard and praised for its unique link to 1-2-3® worksheets.

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Demo Offer, PO Box 4075, Woburn, MA 01888-9822.

Freelance Plus by Lotus



Blue Max Monolith 486/33, \$8,726

cover setup and the initial use of the machine in clear and concise language that will prove useful to almost anyone.

The Blue Max takes a nosedive in the area of service and support. I³ provides the expected telephone support for those nagging procedural and technical questions, but its service policy is hardly equal to the price its machine commands. The computer is covered for a full year on parts and labor, but repairs require shipping the equipment back to I³ or the dealer from whom you purchased it. In the light of the sticker price, the vendor should make some effort to provide on-site servicing even if only for the most extreme cases.

While the price of the Blue Max Monolith 486/33 is not out of line with some of the other computers we reviewed, and its performance is certainly at least as good as many, the lack of on-site service or any real distinguishing features makes it difficult to recommend.

MICRO EXPRESS

Micro Express ME 486-ISA/33

by Bill O'Brien

Micro Express is targeting its ME 486-ISA/33 at those in the market for a network server. The \$7,224 price includes not only 8MB of RAM, 128K processor RAM cache, a 330MB ESDI hard disk, a Super VGA color display subsystem, one parallel and two serial ports, and DOS 4.01, but also a roomy tower case with ten half-height drive bays.

The outside doesn't give much of a clue to the expansion possibilities within.

COVER STORY 33-MHz 486 PCs

From all appearances this is just another tower model with 1.2MB and 1.44MB floppy disk drives accessible from a front panel, which is itself decorated by power, turbo, and reset buttons and their associated LEDs. But the front panel in this case is actually a door; unlocking it reveals the cavernous interior bays that nearly fill the machine from top to bottom.

Supplying power to the box is a massive Interface Electronics 250-watt power supply that takes up the bottom of the tower case. It's a dual-fan model with a thermistor heat sensor that modulates the speed of the fans according to the interior temperature of the case. Fitting it to ten drives will be a problem, as it has five device connectors, but if you really fill all of the drive bays, it's safer to select one of Micro Express's larger optional power supplies to handle the current, anyway.

The only markings on the motherboard identify it as a 486LC, which Micro Express claims is an AMI board. Indeed, it carries an AMI BIOS, but it shares little similarity to the AMI Voyager boards seen in several other computers. This board carries a full array of eight 16-bit slots, five of which are available for expansion after the video adapter, disk controller, and parallel/serial boards are installed. Prominent on the motherboard is a long expanse of SIMM sockets that contain the 8MB of 60-nanosecond devices, with room for an additional 8MB to fill the system to its 16MB maximum. A discrete IC array manages both the 80486 functions and the processor RAM cache.

The ME 486-ISA/33 uses 128K of cache SRAM, but Micro Express has chosen a somewhat slower-than-average 35-ns. version of the chips. This poses no problem for the computer, which offered scores well within the average range on PC Magazine Labs' processor benchmark tests. Yet one can only imagine what 15-ns. or 20-ns. devices would have done for the unit (besides raising the system price by several hundred dollars).

The Seagate hard disk was attached to an UltraStor ESDI controller with a 32K buffer, an arrangement that is finding greater acceptance among purchasers than the higher-priced caching controllers. The 32K read buffer on the controller card is very small in view of the large quantity of data in our large- and small-record DOS File Access tests. Moreover, these tests use both read and write routines, so the

FACT FILE

Micro Express ME 486-ISA/33

Micro Express, 1801
Carnegie Ave.,
Santa Ana, CA
92705; 800-6427-
621, 714-852-1400.

List Price: With
4MB RAM, 128K
RAM cache, 150MB
hard disk, 1.2MB
floppy disk drive,
Super VGA color
display subsystem,
one parallel and two
serial ports, DOS 4.01, \$6,424; with 8MB
RAM, 330MB hard disk, \$7,224.

In Short: Ten drive bays give the Micro Express ME 486-ISA/33 extra capacity inside its roomy tower case. Excellent performance and a two-year warranty are pluses, but the skimpy documentation and lack of on-site service may deter some buyers.



CIRCLE 423 ON READER SERVICE CARD

read buffer is somewhat ineffective. Still, the disk showed above-average performance—something we've come to expect of ESDI drives in general.

The ME VGA Extended video card may not ring any bells for you, but with its Tseng Laboratories chip set and video BIOS shadowing enabled, it managed to rank among the top ten video boards tested here. Micro Express coupled the card with a NEC MultiSync 3D monitor, a pairing that brings forth some exquisite video images.

A lack of good documentation afflicts the ME 486-ISA/33, like many of its counterparts. The motherboard manual is a technical reference volume describing the hardware, and the pamphlet covering the ESDI controller is little better. The



Micro Express ME 486-ISA/33, \$7,224

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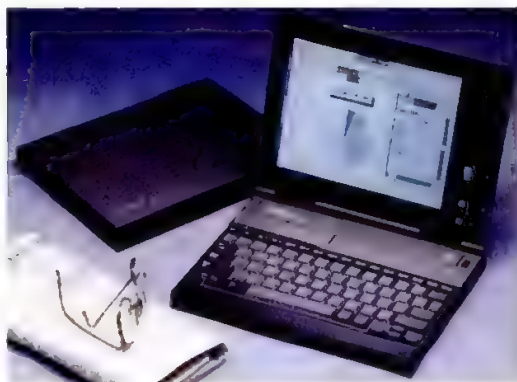


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For more information call
1-800-527-3500.


**TEXAS
INSTRUMENTS**

VGA manual is better but unfortunately covers only the various setup and driver installations you might need.

Micro Express offers phone support for the system and also provides a 30-day money-back guarantee. If you decide to keep it, the ME 486-ISA/33 is covered for two full years on parts and labor. You can obtain service either by sending the unit back to the manufacturer or through parts shipping after phone diagnostics.

At the time of the review, the ME 486-ISA/33 was so new to the market that it had no FCC rating at all, although it has been submitted for Class B approval. While the 486/33 arena is filled with computers of comparable price and performance, the double-length warranty period and good expansion possibilities may be the buying incentive you seek.

MICRO TELESIS INC.

Micro Telesis 486/33

by Bill O'Brien

Subdued strength is the visual impression of the Micro Telesis mini-tower, a machine whose small size might hide the inherent power of its 33-MHz 80486, 8MB of RAM, 200MB hard disk, dual floppy disk drives, and Super VGA display subsystem (not to mention one parallel and two serial ports and DOS 4.01). The \$7,199 premium price attached to the 16- by 8.5- by 19-inch system is a better clue to its nature.

The Munchkin tower represents a collaboration of space management and functional design, with an LCD proudly announcing the 33-MHz operating speed. The number does change to 8 MHz if you drop down to compatibility mode, but in this day and age we can only hope that there's never a need to hamstring a 33-MHz 486 in such a manner. Use the display to broadcast the machine's prowess at full speed.

The fully visible status panel carries power, turbo, and reset switches. The usual complement of LEDs indicates activity in the various areas. A full-length hinged door hides the three half-height bays, which hold accessible drives (two were installed), and two additional bays extend down into the case. An A-Matic 200-watt power supply should be ample for the device count.

SIC Research was the source of the motherboard and, like most of the system

boards seen in this review, it uses discrete components to manage the 486 and the processor RAM cache; BIOS chores have been handed off to AMI. Seven 16-bit slots and one 32-bit slot grace the board for memory expansion beyond the 8MB motherboard limit to a 16MB maximum. SIC provides the parallel and serial ports directly from the motherboard, an arrangement that keeps five slots available for future use.

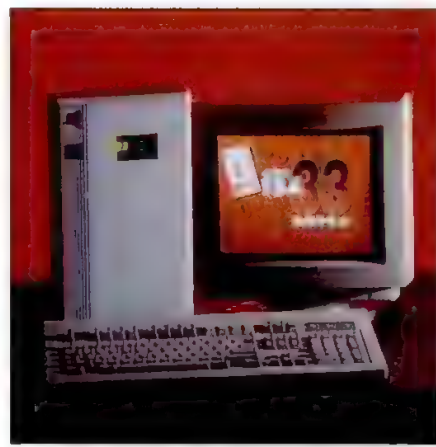
The Micro Telesis 486/33 came loaded with 8MB of 70-nanosecond system memory backed by 64K of superfast 15-ns. cache SRAM. The cache size can be bumped up to 256K, but as the current cache level leaves nothing to desired from a performance standpoint, this hardly seems necessary. Keep in mind that the computer's showing on PC Magazine Labs' processor and memory benchmark test suite was not assisted by BIOS shadowing.

NO REFRESHING CHANGE

Micro Telesis selected a Rodime 200MB IDE hard disk for its 486/33. Rodime is an old name in hard disks, but a relatively rare one among the Maxtor and Seagate drives more typically offered of late. While we would like to report that this is a refreshing change, it's not. The drive is patently slow when put through the paces of our large- and small-record DOS File Access tests. Micro Telesis does offer

other drive choices, and the few hundred dollars' difference between this and a 300MB ESDI drive from its collection would be money well spent.

Video picks up the pace with an EMK-16 VGA1024 Super VGA board. While the card's name may conjure up a blank in



Micro Telesis 486/33, \$7,199

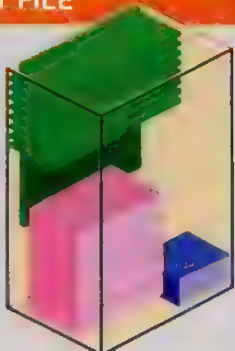
your mind, on screen it provided vivid graphics images and crisp text characters when paired with the Impressions 1024 monitor. It's no slouch in the speed department, either. Powered by a WDC BIOS, it turned in superlative scores on both of our Video BIOS Routine tests; it showed some weakness only when direct writes to the screen bypassed the BIOS entirely.

The Micro Telesis documentation basically consists of a technical reference tome for the TP486/33 motherboard. This documentation is excellent for what it is, but it falls short of providing any practical start-up information apart from instructions for configuring the CMOS setup (which should already be done for you when the computer arrives).

Micro Telesis covers the system for 13 months on all parts and labor, with phone diagnostics and parts shipping to replace defective materials. Considering the substantial price of the computer, you might expect some form of on-site service, but the Micro Telesis policy calls for you to return the system for repair should you be unable to resolve the difficulty over the telephone with the company's technical support staff.

A better hard disk offering in the 200MB range and a more flexible service policy would make the Micro Telesis 486/33 a winner even at its present price level, but without these assets the choice is difficult to make.

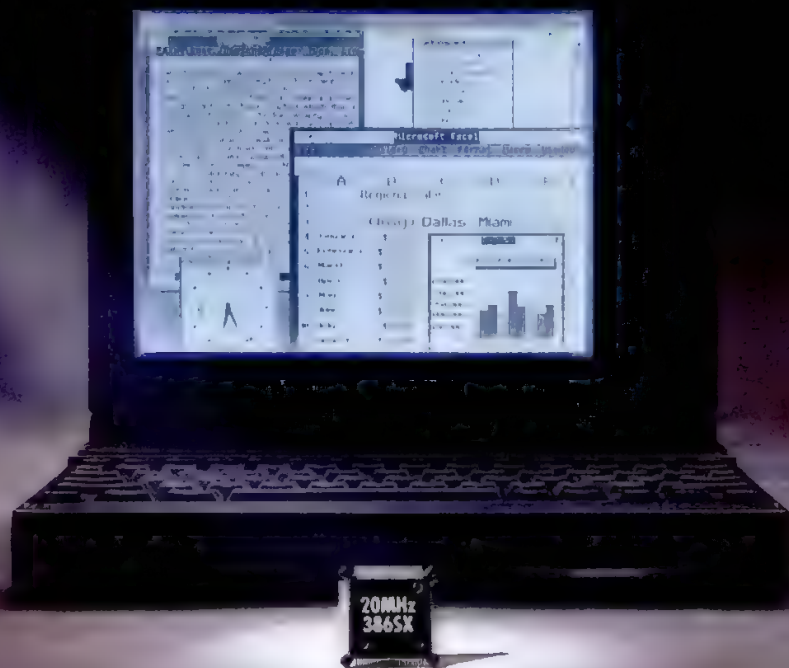
FACT FILE



Micro Telesis 486/33
Micro Telesis Inc., 1260 Logan A-2, Costa Mesa, CA 92626; 714-557-2003.
List Price: With 4MB RAM, 150MB hard disk, 1.2MB and 1.44MB floppy disk drives, Super VGA color display subsystem, one parallel and two serial ports, DOS 4.01, \$6,799; with 8MB RAM, 200MB hard disk, \$7,199.
In Short: The mini-tower Micro Telesis 486/33 turned in some excellent processor, memory, and video test scores, but it would benefit from a faster hard disk. Phone diagnostics and parts shipping substitute for on-site service.

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"...the machine could reliably handle everything I piled onto it." "The systems from ACMA Computer, Inc. inspire confidence." "Clearly, ACMA intends to be competitive, not only in terms of system bang for the buck, but also in the realm of intangibles like technical support and product warranty." (April & July 1990)

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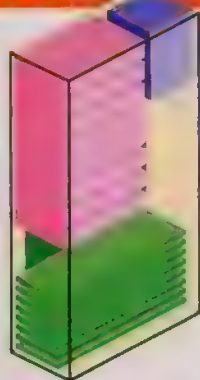
**NATIONAL
MICRO SYSTEMS INC.**
Flash 486-33
by Bill O'Brien

If 33-MHz 80486 machines are supposed to be today's powerhouses, with towering performance matched by equally towering price tags, then National Micro Systems has missed the mark. Oh, it got the performance part of the equation right, but there is nothing towering about the \$4,999 price of its Flash 486-33 tower computer, complete with 8MB of RAM, an ESDI 300MB hard disk, a 1.2MB floppy disk drive, a Super VGA display subsystem, one parallel and two serial ports, a game port, and DOS 3.3.

You might expect that the company has accomplished this price-cutting feat with some severe corner-cutting, but there is no evidence of that. The fairly standard tower enclosure provides front-mounted power, reset, and turbo buttons. Three half-height drive bays are accessible through the front panel, but these account for less than half of the possible drive expansion. Five more half-height bays hide behind the front panel, giving you room for enough storage devices to handle most network needs should you choose to make the Flash 486-33 a file server. If you do fill all of the drive bays, you'll probably need to upgrade the power supply, but the 230-watt DVE unit supplied should get you more than half the way there.



Flash 486-33
National Micro Systems Inc.,
2833 Peterson Pl.,
Norcross, GA
30071; 800-642-
7649 (sales), 800-
448-0781 (tech),
404-446-0520.
List Price: With
4MB RAM, 128K
RAM cache,
150MB hard disk,
1.2MB floppy disk
drive, Super VGA
color display subsystem, one parallel and two
serial ports, game port, DOS 3.3, \$4,499; with
8MB RAM, 300MB hard disk, \$4,999.
In Short: At \$4,999, the Flash 486-33
represents a fine buy, complete with name-
brand components and expandability to 24MB.
A slightly extended warranty is a plus but not a
substitute for on-site service.



CIRCLE 425 ON READER SERVICE CARD

COVER STORY
33-MHz 486 PCs

National Micro Systems hasn't pinched on the motherboard either. It's an AMI Voyager board that relies heavily on discrete components in place of the higher-



Flash 486-33, \$4,999

tech large-scale integrated devices sometimes used as the processor chip set and cache controller. That is possibly the only concession to cost-effectiveness, but it hasn't cost anything in performance. On our tested unit, the board was populated with 8MB of 70-nanosecond RAM backed by 128K of 25-ns. cache SRAM, a combination that fell right in line with the memory and processor benchmark test scores of the other machines we reviewed in this roundup.

There's no scrimping on expansion with the Voyager board, either. While the motherboard memory tops out at 8MB, a proprietary slot will accommodate a memory expansion card to bring the system to its maximum of 24MB. There are also two 8-bit and six 16-bit slots. Five of the eight remain open after video, disk controller, and parallel/serial boards are inserted.

System BIOS shadowing is always enabled on AMI Voyager boards, and video BIOS shadowing can be set through the standard CMOS setup routine.

Perhaps the most surprising feature at this price level is the Maxtor 300MB ESDI hard disk and UltraStor controller. PC Magazine Labs' suite of disk tests takes little advantage of the controller's 32K buffer, but even so, the pair managed to finish with above-average performance speeds.

National Micro Systems has also tossed in a 16-bit Ahead Wizard Super VGA

card and a TVM 3a multiscanning monitor. While neither of these is a household name, they proved slightly better-than-average performers on our video tests. What's more, the appearance of text and graphics is spectacular.

National Micro Systems has bunched together a typical collection of third-party technical manuals, but as is often the case, there's practically no user documentation. Fortunately, NMS does provide phone support to help you through your questions.

Service is a definite plus, with the company offering help through phone diagnostics and parts shipping. National Micro Systems covers the Flash 486-33 for 15 months on parts and two years on labor.

Normally, midlevel managers end up with something on the declining edge of technology as their computer systems. The Flash 486-33's price is a more than reasonable excuse to put an end to that. Its FCC Class A rating will confine it to offices, but it's a class A machine that should make a great working tool, whether on someone's desktop or as a server.

**NORTHGATE
COMPUTER SYSTEMS INC.**
**Northgate
Elegance 486/33**
by Bill O'Brien

It's hardly accidental that Northgate Computer Systems has achieved prominence in the field for its innovative Elegance series. The latest version of the line, an 80486 tower system running at 33 MHz, will certainly add to the company's credentials.

With a standard configuration price of \$7,195, the Northgate Elegance 486/33 is less costly than many of the computers in this review. Along with 8MB of RAM, a 64K RAM cache, a 200MB hard disk, dual floppy disk drives, a Super VGA display subsystem, two parallel and two serial ports, and DOS 4.01, you get *Microsoft Windows 3.01*, *Ami Professional*, and *Wingz*. A basic configuration, without the software and with 4MB of RAM and a Hercules monochrome display subsystem, is also available from the company. It lists for \$6,199.

This is a new tower enclosure for Northgate, and there are a few changes to



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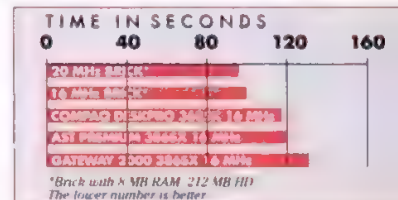
This new generation PC is remarkable for the performance and the practicality it provides. The Brick is powerful enough for the most demanding applications, while its elegance, quietness and size make traditional PC's seem downright obtrusive by comparison.

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"A Tote-able that Outperforms the Desktops..."

Consistently outperforms both Compaq's and IBM's 386SX on the PC Labs computer benchmark tests...Ergo's Brick maintains the functionality of a Desktop PC within a small form factor"

— PC MAGAZINE, Sept. 1990



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aggregate of system, video and hard disk benchmarks.

Massive Hard Disk

Bricks are available with 16 or 20 MHz 386SX, 1-8 MB of RAM, a fast 44, 104 or 212 MB Conner or Teac IDE hard disk, and a 387 coprocessor socket. A 2,400 bps Hayes compatible modem is standard.

The fast VGA graphics feature up to 1024 x 768 non interlaced resolution with a full 1 MB of video memory. In fact, the Brick's video performance is twice as fast as the average of 42 386SX systems tested by *PC Magazine!* This makes an enormous difference in the perceived "response" of the system, especially if you're running graphically intensive applications like Windows or Desktop Publishing.

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The Brick is only about the size of a ream of copier paper, yet you can still add up to two ISA half cards internally, (one card with a floppy drive). A docking port allows easy, drop-in connection to our Docking Terminal, (\$249, available Q1 1991) which instantly hooks up all cables and provides another 16-bit 3/4 length slot. The "stretch" version of the Brick accommodates full length cards.



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When you need to travel, just add the optional VGA LCD module, (\$895, available Q1 1991) and our Brick Bag for a completely self-contained, AC powered portable system.

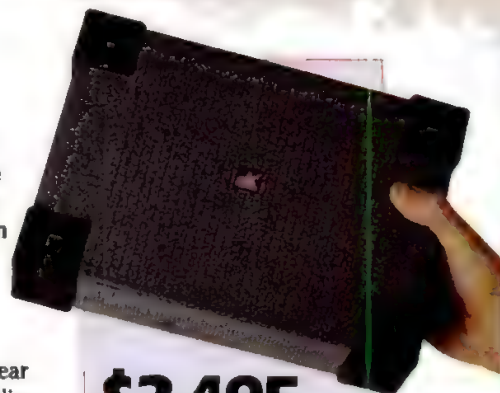
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AST
COMPUTERS

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enough to contain all the key system components, including the 486/33, an Opti chip set, a socket for a Weitek 4167 math coprocessor, and a relatively uncommon BIOS from Microid Research called MR BIOS, which supports both system and video BIOS shadowing. Also on the motherboard are eight SIMM sockets, for a maximum of 8MB of RAM; our tested unit included eight 1MB SIMMs rated at 70 nanoseconds. You can set the processor to operate at 20 or 33 MHz and the bus to run at 8, 10, or 12 MHz.

If you need more than 8MB of RAM, Novacor sells a \$195 memory board with a maximum capacity of 8MB of DIP-type RAM. At the time of this review, Novacor's prices for memory were \$100 for 1MB, \$200 for 2MB, \$300 for 4MB, and \$600 for 8MB. The board fits into one of two 32-bit system slots. There was no external cache in the system we tested, but Novacor sells a \$295 128K cache board and a \$395 512K cache board. Either board can fit into the second 32-bit expansion slot.

In addition to the 32-bit slots, the motherboard in the tested unit included one 8-bit and five 16-bit slots. Three slots were filled with the Novas 4000 video board, a Novacor disk controller with the IDE connector for the Conner hard disk, and an I/O board. A fourth slot was blocked by additional connectors, but Novacor says that it can provide appropriate connectors for the cutouts on the back panel.

33-MHz 486 PCs



Novas OPTimum 486-33, \$6,286

To save yet another slot, the company will soon offer a combination disk controller and I/O card.

In our tests, the OPTimum 486-33's performance was about average for the group, with disk speeds falling somewhat below the norm. Overall, however, the system's performance is pretty much in line with its price.

With FCC Class A certification and a one-year parts-and-labor warranty, this is a decent if not impressive system. For accommodating storage devices, its expansion capabilities are better than average; for accepting interface cards, they are less than they might be, particularly if you tie up two slots with the RAM and cache boards. In the end, there is no overwhelming reason to select or reject the Novas OPTimum 486-33.

cludes an ExpenTech 200-watt power supply to handle the load, and it should work well even with all of the bays filled.

The platform for the computer is an Award Vantage motherboard with a few surprises. There are eight 16-bit expansion slots, and none are used for memory expansion. The tested machine had 8MB installed; you can bring the computer to its maximum 16MB via SIMM slots on the motherboard. The system uses an Award BIOS, an Opti chip set, and no cache controller. The tested Panther 486/33 came with 70-nanosecond SIMMs, which is certainly typical for many of the 33-MHz machines, but without external cache RAM.

The Panther 486/33 proved to be a somewhat below-average performer on PC Magazine Labs' 80486 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests, but it achieved its scores solely by means of its processor, chip set, and memory management, and the internal cache on the 486 processor chip. The strength of its components prevented the lack of on-board RAM cache from dropping this system's scores below the others.

The Maxtor LXT-200A hard disk installed offered 200MB of RAM and a 15-millisecond access time. It's not the first time this IDE drive has turned up in a PC Magazine review, and as expected, its performance was slightly above average through the large- and small-record DOS File Access tests. Video chores are handled

FACT FILE

Novas OPTimum 486-33
Novacor Inc., 1841 Zanker Rd., San Jose, CA 95112; 800-486-6682, 408-441-6500.
List Price: With 1MB RAM, 1.2MB or 1.44MB floppy disk drive, monochrome display subsystem, one parallel and two serial ports, game port, \$3,786; with 8MB RAM, 200MB hard disk, 1,024-by-768 color display subsystem, DOS 4.01, \$6,601; with both floppy disk drives, Super VGA video adapter, VGA color monitor, \$6,286.
In Short: The Novas OPTimum 486-33's tower form factor offers plenty of room for expansion at a reasonable price. The motherboard lacks external cache, but it does not particularly suffer on PC Magazine Labs' benchmark tests.

CIRCLE 427 ON READER SERVICE CARD

PANTHER SYSTEMS LTD. Panther 486/33 by Bill O'Brien

Panther Systems' \$4,999 486/33, complete with 8MB of RAM, a 200MB hard disk, a 1.2MB floppy disk drive, a VGA display subsystem, one parallel and two serial ports, DOS 4.01, and a mouse, is among the least expensive machines reviewed. What's more, it doesn't suffer in comparison with higher-priced models.

The Panther 486/33's case is a 25-by-7.5-by-16-inch tower cabinet with power, reset, and turbo buttons mounted at the top of the front panel. Three half-height bays poke through the panel, and three more are tucked away behind it. Panther in-

FACT FILE

Panther 486/33
Panther Systems Ltd., 111 Great Neck Rd., #305, Great Neck, NY 11021; 800-272-6843, 516-466-6108.
List Price: With 4MB RAM, 150MB hard disk, 1.2MB floppy disk drive, VGA display subsystem, one parallel and two serial ports, DOS 4.01, \$4,499; with 8MB RAM, 200MB hard disk, Logitech Mouse, \$4,999.
In Short: A low-priced, well-configured system, the Panther 486/33 comes with a remarkable three-year warranty and an unusual upgrade policy that makes it worth your while to buy the best components the company offers.

CIRCLE 428 ON READER SERVICE CARD

by a somewhat generic Panther VGA card with WDC chips, coupled to an ADI monitor. Visually the pair work well together, and they put out above-average performance on PC Labs' video tests.

To say that there is no documentation with the Panther 486/33 would be to exaggerate—but only slightly. Accompanying our system was a motherboard manual with a large Panther label pasted on it and a user manual for the included Dexxa Mouse. The mouse manual is the thicker and more informative of the two.

Panther would prefer that you buy your system configured with the best peripherals it sells. The company's motherboard upgrade policy lets you trade in your old motherboard for a newer version (for a fee)—although it could be a while before

back guarantee, so you can take your time to decide whether the system meets your needs. Most users probably won't want to return their Panthers, though: The machine works the way it should, carries an impressive warranty, and will be as effective an office assistant as any other computer you might choose.

PC BRAND INC.

PC Brand 486/33

by Fredric Burke

The low \$5,908 price for PC Brand's 486/33 that meets *PC Magazine's* standard configuration—8MB of RAM, a 200MB hard disk, a 1.2MB floppy disk drive, a Super VGA display subsystem, one parallel and two serial ports, and DOS 4.01—is made even more attractive when matched up with the system's solid performance. The combination is one that could send many of its competitors packing.

The PC Brand 486/33 has a traditional desktop design measuring 6.5 by 19 by 16 inches. Attractively styled, it shows signs of being built to cost: What appears to be a knockout for a vertically mounted 3.5-inch drive bay has a fan behind it, rendering the potential bay unusable.

Other than that, PC Brand has taken good care in designing its 486/33. The company makes its own motherboard, which offers three bus speeds you can select: 8.25, 11, and 16.5 MHz. Opti provides the supporting chip set and Microid

Research the BIOS, which can be shadowed in both system and video modes. The cache can be configured up to 256K of 25-nanosecond DIPs, in either a single 256K chip (as in the tested version) or with eight 32K chips.

The PC Brand 486/33 also supports simultaneous use of a Weitek 4167 coprocessor, but instead of using a socket on the motherboard, it is mounted on a proprietary card that sits in a dedicated 16-bit slot.

Keeping in mind the value of the 486/33 for the memory-intensive applications found in most CAD and DTP environments, PC Brand did not skimp in the RAM department. While the tested unit came with 8MB of RAM, the motherboard will support up to 32MB of 70-ns. SIMMs, packaged in 4MB chips. An



Panther 486/33, \$4,999

a 33-MHz 486 motherboard is made obsolete by something else. This upgrade policy does not extend to peripherals, so getting the best with the original purchase does make sense if you plan to take Panther up on its offer.

Panther has raised the stakes in the service arena. Any board in the computer, including the motherboard, is covered for three years on parts and labor. This may be a cunning ploy in the hope that you'll trade up more often than you'll break down, but it's an outstanding value nonetheless. Other system components, such as the power supply, hard disk, floppy disk drives, and monitor, carry a more conventional one-year warranty on parts and labor. Service is accomplished over the phone, with Panther claiming a 48-hour turnaround time for replacement parts. On-site service from GE is an optional extra.

Panther also offers a 45-day money-



PC Brand 486/33, \$5,908

upgrade to 32MB is \$2,520, which is not so terrible when you consider that the machine has a pretty low price tag to begin with.

PC Brand has sidestepped the issue of 8-bit slots taking up space on the motherboard by simply not building any. The motherboard has seven 16-bit slots, plus the proprietary slot for the coprocessor. With a 16-bit Cardinal VGA 700 video card (connected to a GoldStar 1460 Plus Super VGA monitor) and an integrated floppy/hard disk controller and I/O card, the same five 16-bit slots found in most other machines remain, along with the extra 16-bit slot.

The PC Brand 486/33 also includes a little more than the requisite number of drive bays. Not counting the bogus 3.5-inch knockout, there is room for five half-height drives—three external and two internal—and a single 3.5-inch drive. The tested machine came with an internally-



FACT FILE

PC
Brand
486/33
PC
Brand
Inc.,

954 W. Washington
St., Chicago, IL 60607; 800-722-7263.
List Price: With 1MB RAM, 1.2MB or 1.44MB
floppy disk drive, monochrome display
subsystem, one parallel and two serial ports,
\$3,619; with 8MB RAM, 200MB hard disk,
1.2MB floppy disk drive, Super VGA display
subsystem, DOS 4.01, \$5,908.

In Short: The PC Brand 486/33 was a
surprise here, showing better speed and
expansion than some machines costing twice
as much. This machine is not just for the
budget-conscious; it will prove useful for any
serious CAD or DTP applications.

CIRCLE 429 ON READER SERVICE CARD

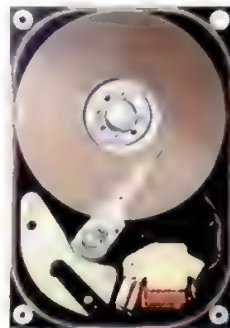
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OUR ATTENTION
THAT NOT EVERYONE
BELIEVES
PORTABLE PCs
CAN BE AS
FUNCTIONAL AS
DESKTOP PCs.



THIS SHOULD



This may be hard to believe, but there really is such a thing as a portable PC that can do everything a conventional desktop can.



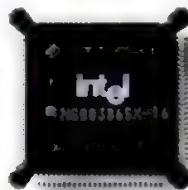
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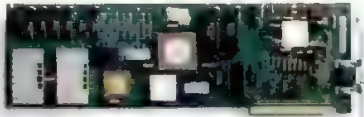


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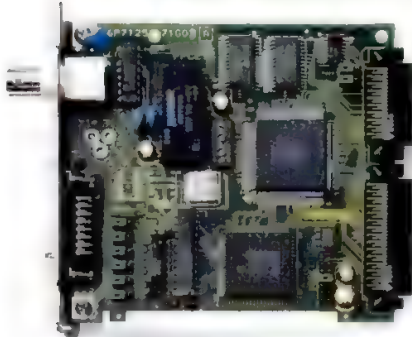


tops run all of the same applications as your company's conventional PCs.

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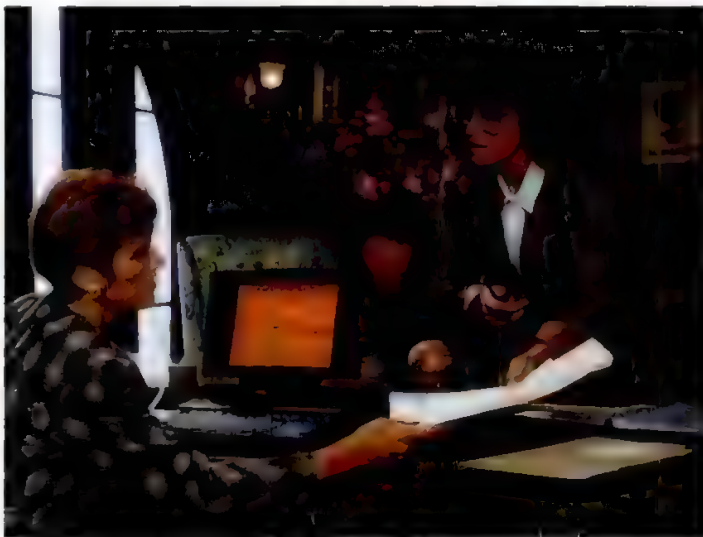
Then your key employees can turn after-hours time into productive time, since their dining room tables and breakfast nooks can serve as off-site workstations.

Your top people can add impact to their presentations with a

wealth of information and computing power at their fingertips. And the story can repeat itself—with equally impressive results—everywhere from an office 3,000 miles away to a conference room that's a mere 30 feet down the hall.



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your best people can be doing a better job than they ever could when they were chained to conventional desktop PCs.

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And yes, all that productivity can even take place within the confines of your own office desk (while using up considerably less of your desk space, we might add).

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Now all of



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18.7 pounds, 20MHz 80386 with 80387-20 coprocessor socket, 2 internal IBM-compatible expansion slots, 40MB hard disk with 25msec access or 100MB hard disk with 25msec access or 200MB hard disk with 16msec access, 2MB RAM expandable to 14MB, gas plasma VGA display with 16 gray scales, 1.44MB 3½" diskette drive.

T5200C

18.9 pounds, 20MHz, 80386 with 80387-20 coprocessor socket, 2 internal IBM-compatible expansion slots, 200MB hard disk with 16msec access, 2MB RAM expandable to 14MB, passive matrix VGA full-color screen, 1.44MB 3½" diskette drive.



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17.0 pounds, 16MHz 80386SX with 80387SX-16 coprocessor socket, 2 internal IBM-compatible expansion slots, 1 dedicated modem slot, 5 built-in ports, 40MB hard disk with 25msec access or 120MB hard disk with 19msec access, 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales, 1.44MB 3 1/2" diskette drive.



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What do other companies know about our Portable Desktop PCs that you don't? If you had a copy of our free productivity survey, you'd know. For example, you'd know that 93 percent of portable users said that they'd never go back to using a conventional desktop. You'd know they've reported substantial increases in productivity. And you'd know why they place so much value on the flexibility and freedom their portables have to offer. Toshiba Portable Desktops. They're no longer a matter of convenience, they're a matter of survival.

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Toshiba America Information Systems Inc., Computer Systems Division.

CIRCLE 379 ON READER SERVICE CARD

mounted 200MB Maxtor IDE hard disk and a Mitsumi 1.2MB floppy disk drive. An additional 1.2MB or 1.44MB floppy disk drive is available for \$75, and hard disks are available in versions up to a 640MB ESDI disk that sells for \$2,610. The Due 200-watt power supply is fine for standalone use but is not up to networking tasks.

The company makes *QEMM 5.1* available for \$65, and you can get *Microsoft Windows 3.0* and a mouse thrown in for an additional \$86.

PC Brand provides a warranty on parts for five years and service for one. On-site service is provided by TRW. PC Brand also offers an 800 number for technical support, with parts shipping when required.

The PC Brand 486/33 is impressive all around, with the expected midrange performance scores on most benchmark tests, and some better-than-decent video scores. All told, the product is a better value than certain offerings from other, better-known companies. For a good number of users, the search for a 486/33 will end with this machine.

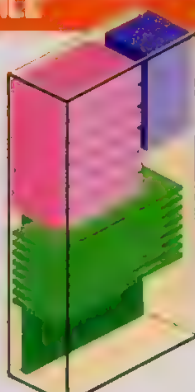
PC PROS/TOUCHE MICRO TECHNOLOGIES Touche 486-33 Model 5550

by Kellyn S. Betts

Touche Micro Technologies' stated goal is to keep improving the quality of its offerings, but the Touche 486-33 Model 5550 is going to be hard to top. Solid construction, good performance, and a low price make the unit outstanding.

For \$5,199, Touche provides a 33-MHz 486 system with 8MB of RAM, a 128K processor RAM cache, a 198MB hard disk, one 1.2MB and one 1.44MB floppy disk drive, an Orchid ProDesigner II Super VGA adapter with 1MiB of video RAM, a Sony MultiScan HG Super VGA monitor, two parallel and two serial ports, a 101-key Key Tronic keyboard, and DOS 4.01. The company will also sell a system shell with 4MB of RAM, the RAM cache, and one floppy disk drive for \$2,999, a price that might appeal to a bargain hunter who knows where to get his hands on some inexpensive components. Our evaluation unit came with a 14.5-millisecond 338MB Maxtor hard disk, which brought

COVER STORY 33-MHz 486 PCs



FACT FILE

Touche 486-33 Model 5550
PC Pros/Touche Micro Technologies, 8205 S. Cass Ave., Darien, IL 60559; 708-810-1010.
List Price: With 4MB RAM, 128K RAM cache, 1.2MB or 1.44MB floppy disk drive, one parallel and two serial ports, monochrome display subsystem, power case, \$3,398; with 8MB RAM, 198MB hard disk, both floppy disk drives, Sony Multiscan HG Super VGA monitor, two parallel and two serial ports, DOS 4.01, \$5,199; with 338MB hard disk, \$5,499.
In Short: This well-constructed, well-performing machine has enough special extra touches to justify almost any price PC Pros might demand for it.

CIRCLE 542 ON READER SERVICE CARD

the total system price up to \$5,499.

The Model 5550 is housed in a sturdy, attractive tower-style case that measures 24 by 7.5 by 17 inches. The machine comes with some small extras, among them a tower case stand and a screwdriver. Its ROM setup program is extensive, providing diagnostics and performance tests as well as allowing you to change the speed of the I/O bus from 8 to 12 MHz; to accomplish this you'll also have to swap the I/O bus crystal.

Inside the case are a number of name-brand components. The AMI motherboard contains a 128K RAM cache comprising 25-nanosecond DIP chips, as well as an AMI BIOS and a Chips and Technologies chip set. The tested unit's 8MB of system memory consisted of 1MB SIMMs rated at 70 ns., but the system supports 4MB modules as well, allowing it to house 32MB on the motherboard.

The Model 5550 has eight expansion slots, three of which were filled with the machine's Boca I/O card, Orchid ProDesigner II video card, and UltraStor floppy/hard disk controller. That leaves one 8-bit and four 16-bit slots open; the 8-bit slot can also hold the system's optional full-size memory board. The system has six half-height (or three full-height) bays, some of which were filled with the 338MB Maxtor ESDI hard disk and 1.2MB and 1.44MB TEAC floppy disk drives. All the mass storage devices were grounded. The

power supply is an ample 250-watt unit from Enhance Electronics.

In our tested system, each of the wires and cables connecting the machine's many parts to each other and to the motherboard was clearly labeled with a Mylar tag, which would have greatly eased the task of troubleshooting if we had encountered any problems. Providing these tags doubles the time required to prep a tower system before delivery, according to a Touche system support specialist. He admitted, however, that such prep work is done only if time allows.

The Model 5550 did consistently well on our tests. All of these machines exhibited similar processor performance, but the Model 5550's was in the top quarter. The system had the best time of all on our small-record DOS File Access test, and it came in second on the large-record test. Its video scores were less impressive, though they still fell in the top half of the pack.

Lest we sound too enthusiastic, we do have to voice a couple of minor complaints about the unit. For one, its documentation is little more than a collection of manuals made by the manufacturers of its component parts. And the system could use an additional fan at its base to draw in cool air, which the power supply could pull across the unit. These are minor complaints, however, as most power users should find the manuals sufficient, and the system didn't seem to run too hot.

Touche's entry comes with an FCC Class B certification and a one-year parts-and-labor warranty, and it is backed by on-site service from TRW. It offers almost everything a power user could want in a PC at a price that should encourage quantity purchases.



Touche 486-33 Model 5550, \$5,499

PEREGRINE COMPUTERS

Peregrine 486/33
Flyer

by Fredric Burke

Peregrine has not been on the scene long, but its products have already created an impression with their combination of features and decent performance. The Peregrine 486/33 Flyer is slightly pricey at \$6,999 (with 8MB of RAM, a 128K processor RAM cache, a 200MB hard disk, two floppy disk drives, and a Super VGA display subsystem), but it is a ruggedly constructed machine stocked with quality components. It comes not only with DOS 4.01 but also with a nice selection of software and utilities. And its expansion capabilities make it equally adept in a CAD, DTP, or networking environment.

Inside the Flyer's well-organized tower case, which measures 24 by 7.5 by 17 inches, is the now-common AMI motherboard. Of course, you also get the equally familiar AMI BIOS, which can be shadowed in both system and video modes. The motherboard eschews a traditional chip set, employing instead a discrete logic arrangement. It also features a fixed 128K cache, packaged in 25-nanosecond DIP chips, and a socket for an Intel or a Weitek 4167 coprocessor, though it will not support them simultaneously.

The Flyer has expansion abilities that allow users to take greater advantage of

the machine. It can expand its system RAM from the 8MB on our tested version to 24MB. While the motherboard will support only 8MB in 60-ns. 1MB SIMMs, an optional \$225 32-bit add-in card can be populated with up to 8MB if you use 256K chips, or 16MB using 1MB SIMMs.

Six 16-bit slots and a single 8-bit slot are found on the Flyer's motherboard, in addition to the 32-bit proprietary slot. In the test machine, one 16-bit slot was taken up by Orchid's 16-bit ProDesigner II video card and another by a combined floppy/hard disk controller and I/O board.

Peregrine makes good use of the space inherent in a tower design, providing users



Peregrine 486 33 Flyer. \$6,999

with six half-height drive bays—four external and two internal. The tested version came with a 200MB Maxtor IDE hard disk as well as 1.2MB and 1.44MB TEAC floppy disk drives.

Peregrine has ensured that the 486/33 Flyer is equal to any tasks it will be called on to perform. A PC Power and Cooling Innersource 210 power supply provides 300 watts of power, and a Monitronix 14-inch Super VGA monitor handles video duties. Unlike some other companies in this roundup, Peregrine bundles extra software with its 486. Included are *Microsoft Windows 3.0* (you get a Microsoft Mouse, too), *SmartDrive* disk-caching utilities, and the LIM 4.0 expanded memory manager.

Service for the 486/33 Flyer is strictly standard fare: You get a one-year warranty on parts and labor. Peregrine also maintains toll-free phone service with parts shipping, but if a problem can't be solved that way, your defective unit will need a

trip back to the manufacturer.

The Peregrine 486/33 Flyer is a fine performer in a field of excellent machines, offering average scores on our benchmark tests: no amazements and no surprises. If its expansion room, rugged construction, and decent performance appeal to you—and the price is not an issue—check out the Peregrine.

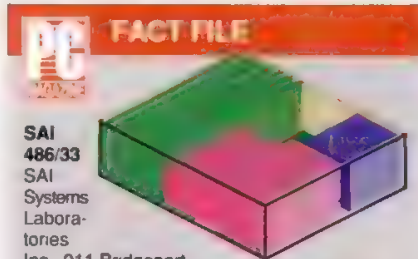
SAI SYSTEMS
LABORATORIES INC.

SAI 486/33

by Fredric Burke

The great 486 trickledown is under way. Every day, new companies come out with machines that provide roughly equal performance and come with comparably low price tags. SAI Systems Laboratories is one such company, and its 486/33 is one such machine. The \$5,195 price for our tested configuration includes 8MB RAM, a 128K external RAM cache, a 212MB hard disk, two floppy disk drives, a Western Digital video card and a Super VGA color monitor, DOS 3.3 or 4.01, *SP Word* software, and an Aero serial mouse. A basic configuration (4MB RAM, the cache, two floppy disk drives, a monochrome display subsystem, and DOS) is available for \$3,395, a price that undercuts many competitors. For users who need a simple, conventional file server, that's all they have to know.

While slightly smaller than other desktop systems, the 6- by 21- by 16-inch SAI 486/33 still qualifies as one. Inside the chassis users will find an AIR motherboard. AMI provides its popular BIOS,

SAI
486/33
SAI
Systems
Labora-
tories

Inc., 911 Bridgeport Ave., Shelton, CT 06484; 203-929-0790. List Price: With 4MB RAM, 128K RAM cache, 1.44MB and 1.2MB floppy disk drives, monochrome display subsystem, *SP Word*, DOS 3.3 or 4.01, \$3,395; with 8MB RAM, 212MB hard disk, Super VGA color display subsystem, serial mouse, \$5,195. In Short: Low price and average performance, combined with decent expansion, aren't enough to recommend an otherwise undistinguished machine. Power users should look elsewhere for their low-price solutions.

CIRCLE 544 ON READER SERVICE CARD

FACT FILE

Peregrine 486/33
Flyer

Peregrine
Computers, 110 E.
Canal St., Troy, OH
45373; 800-326-
7015.

List Price: With
4MB RAM, 128K
RAM cache, 100MB
hard disk, 1.2MB
and 1.44MB floppy
disk drives,
monochrome display
subsystem, DOS

4.01, *Microsoft Windows 3.0*, \$5,999; with
8MB RAM, 200MB hard disk, Super VGA
display subsystem, \$6,999.

In Short: The Peregrine 486/33 Flyer, a
somewhat expensive newcomer, is a solid
performer whose reliance on name-brand
components means that its reliability will not
be called into question.

CIRCLE 543 ON READER SERVICE CARD

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- WINNER -
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for Technical Excellence



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Sharp Electronics Corp.



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CIRCLE 193 ON READER SERVICE CARD

If You're Considering,



AST
Premium 386SX/16
Model 45V



ACER
1100/SX



NEC
PowerMate
SX Plus

Consider The Cost. Then Choose Our New 386SX/20-MHz.

Our new GS318 gives you blazing 386SX/20-MHz speed. At a price that'll take your breath away.

This AT-compatible system combines everything you need for powerhouse performance. Things like 1 MB of RAM, expandable to 8 MB. Built-in 16-bit VGA that supports 1024 x 768 resolution, and is upgradeable to 512K video RAM. There's also plenty of room for add-ons, with five expansion slots—plus parallel, serial and mouse ports on the motherboard.

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GoldStar

CIRCLE 262 ON READER SERVICE CARD

Talk To GoldStar.

STANDARD COMPUTER CORP.

Standard 486/33

by Fredric Burke

and Intel makes the 486 chip set. Intel also makes the fixed 128K RAM cache, which is composed of 30-nanosecond 32K DIP chips. The motherboard has a plug for a Weitek 4167 coprocessor, an item that SAI does not sell.

The unit is expandable only up to 16MB of motherboard system RAM, which is somewhat disappointing when you consider the 24MB or even 32MB capacity of many competitors. The tested unit came with 8MB of RAM, packaged in 70-ns. 1MB SIMMs.

The motherboard boasts seven 16-bit slots. Outfitted with the 16-bit video card and the combined Chicony floppy/hard disk controller and I/O card, the SAI 486/33 still has five 16-bit slots remaining. SAI also makes available five half-height drive bays, three of which are external and two internal. In the tested unit, a 212MB Conner IDE hard disk was installed, as were TEAC 1.2MB and 1.44MB floppy disk drives. Hard disk options range in price up to \$3,295 for a 600MB ESDI unit; a SCSI drive of identical capacity is available for the same amount. A 200-watt LSI power supply provides the oomph.

SAI does a good job of standing behind the 486/33. You get a one-year warranty on parts and three years on labor. Unfortunately, no on-site service is available, so users must ship their units back to the manufacturer if SAI's phone service cannot solve the problem.

The SAI 486/33 works well enough, offering up median benchmark test scores across the board. Users interested in cramming in as much RAM as possible would do better to look elsewhere. But if you just want a small file server, the SAI's memory capacity should be adequate, as should its expansion capabilities.



SAI 486/33, \$5,195

The Standard 486/33 is what many business users will be looking for when it comes time to upgrade from those old, slow 386s. It's a fast, well-equipped, and nicely priced machine, at \$6,315 for our standard configuration including 8MB of

FACT FILE

Standard 486/33
Standard Computer Corp., 12803 Schabarum Ave., Irwindale, CA 91706; 800-662-6111.
List Price: With 4MB RAM, 128K RAM cache, 200MB hard disk, 1.2MB and 1.44MB floppy disk drives, Super VGA display subsystem, DOS 4.01, Microsoft Windows 3.0, mouse, \$5,905; with 8MB RAM, mini-tower case, \$6,315.
In Short: The Standard 486/33 combines the blistering performance of a 486 with a price that undercuts many less capable 386 machines. This model should be considered by those who need the power but don't have much to spend.

CIRCLE 545 ON READER SERVICE CARD

RAM, a 128K external RAM cache, a 200MB hard disk, two high-density floppy disk drives, a Super VGA display subsystem, DOS 4.01, and Microsoft Windows 3.0. The system's basic configuration, in a desktop case with 4MB of RAM, can be had for \$5,905. Standard Computer Corp. expects to sell most units in the mini-tower case that goes for \$90 more.

Standard employs AMI's Voyager motherboard and BIOS inside the 14.5-by 8.5-by 15.25-inch mini-tower. Chips and Technologies provides the chip set. The Standard 486/33 is configured with a fixed discrete-logic 128K cache that uses two 25-nanosecond 64K DIP chips. The motherboard also has a plug for a Weitek 4167 coprocessor.

The system's expansion chassis leaves something to be desired. With a Trident video card (which comes attached to a ViewSonic 4 Super VGA color monitor), NCL's floppy/hard disk controller, and an I/O card occupying one 8-bit and two 16-

bit slots, the user is left with only four 16-bit slots and a single 8-bit slot, which can also take a proprietary 32-bit memory board.

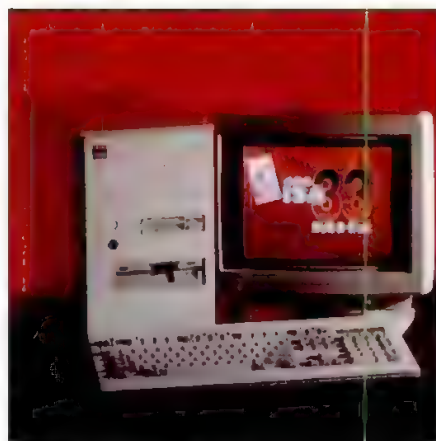
Yet Standard makes up for the somewhat limited board expansion room with its memory capacity. You can install up to 48MB in the Standard 486/33. The motherboard can support either 8MB in 70-ns. 1MB SIMMs or 32MB in 4MB SIMMs. If you use the convertible 8-bit slot as a proprietary 32-bit slot, you can increase the memory by another 16MB. RAM upgrades are available for \$80 per megabyte.

The user has access to five drive bays: three half-height bays accessible from the front and two internal 3.5-inch bays. Our tested version came with a 3.5-inch 200MB Maxtor IDE drive as well as TEAC 1.2MB and 1.44MB floppy disk drives. The interior arrangement of the Standard 486/33 allows pain-free access to the drive bays.

Standard rounds out its package with an NMB 101-key keyboard, a 200-watt Kingspao power supply, and a Hi-Res mouse. LimSim, an expanded memory manager, is available from the company for \$59.

Service is comprehensive: You get a one-year warranty on parts and labor, plus on-site service from TRW. An 800 technical support number and parts shipping complete the deal.

The Standard 486/33, with an FCC Class A rating and benchmark scores that ranked among the top ten percent of these machines across the board, is as complete a package as you can find on the market. While the system could stand one or two more free expansion slots, finding fault with the machine is rather difficult to do, particularly when you take into consid-



Standard 486/33, \$6,315

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But that's only the beginning.

Each ProLine drive also comes with Tecmar's ProServe™ software. ProServe's Value Added Process (VAP™) for NetWare 286 and NetWare Loadable Module (NLM™) for NetWare 386 run concurrently with other applications on the filer server. And ProServe is integrated into the network



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CIRCLE 384 ON READER SERVICE CARD

eration its ample RAM capacity.

The Standard 486/33 computer offers the price and performance to suit just about everyone.

SYSTEMS INTEGRATION ASSOCIATES

SIA 486/33

by Fredric Burke

The SIA 486/33 is built with networking in mind. It's fast and offers plenty of room for drive expansion, but it is also expensive: \$10,725 for our tested configuration with 8MB RAM, a 128K RAM cache, a 322MB hard disk, 1.2MB and 1.44MB floppy disk drives, a Super VGA color display subsystem, DOS 3.31, and LIM 4.0. Even the basic configuration with 4MB of RAM, one floppy disk drive, and no hard disk or video sells for a pricey \$6,696. One of the most striking features of this machine is the number of ways you can configure it; the biggest limitation here is the depth of your pockets.

Inside the well-organized and neatly-finished 24.5- by 9- by 23.5-inch tower case is a motherboard of SIA's own design that employs discrete logic architecture. AMI supplies its popular BIOS, which can be shadowed in both system and video modes. The SIA 486/33 includes a fixed discrete-logic 128K cache, using two 64K DIP chips rated at 25 nanoseconds. Because this computer is going to be called on to do real number-

COVER STORY 33-MHz 486 PCs

crunching, it has the ability to run a Weitek 4167 simultaneously through a socket on the motherboard.

While our tested unit came with 8MB of 80-ns. SIMMs, system memory can be expanded up to 32MB by populating the motherboard with eight 4MB SIMMs at \$465 per bank. You can also spend \$1,165 for a proprietary memory card that comes complete with 8MB already on-board. Additional 8MB banks for the card are \$930 apiece.

For a machine as large as the SIA 486/33, its relatively small expansion chassis is something of a disappointment. You start out with six 16-bit and two 8-bit slots, but after the video card, Adaptec floppy/hard disk controller, and I/O board are installed, you have left only four 16-

The SIA 486/33 is an
impressive performer
that will be appreciated
by the most jaded
power user.

bit slots and a single 8-bit slot that can also house the proprietary 32-bit memory slot. The network or power users for whom the machine was designed may not be terribly pleased with this somewhat limited capacity.

If you're looking to add drives, though, the SIA 486/33 takes the prize. Nearly the entire front of the machine is given over to drive bays. Our tested version came with a huge 322MB Imprimis ESDI hard disk and two 1.2MB Fujitsu floppy disk drives. Even with these devices installed, four externally accessible half-height bays and three internal bays were still available to be filled.

Power requirements for the machine's myriad memory and drive combinations are met by a 450-watt power supply of SIA's own manufacture. SIA also builds the 14-inch Super VGA monitor included in the \$10,725 configuration. The company bundles only Larson's LIM-spec expanded memory manager with the basic configuration; DOS 3.3 or Compaq's DOS



SIA 486/33, \$10,725

3.31 can be had for an additional \$100.

Since SIA sells through dealers, on-site service is handled by them, as are extended service arrangements. SIA does provide a one-year parts-and-labor warranty, as well as a toll-free technical support number.

For those with adequate cash resources, the SIA 486/33 is worthy of attention. It did very well on PC Magazine Labs' processor and disk benchmark tests; its video scores were a little less impressive but still generally above average. While it is slightly hamstrung by the limited number of expansion slots, the SIA 486/33 is an impressive performer whose rugged construction and signs of attention to detail will be appreciated by the most jaded power user.

FACT FILE

SIA 486/33

Systems Integration Associates, 222 E. Pearson St., #502, Chicago, IL 60611; 312-440-1275.

List Price: With 4MB RAM, 128K RAM cache, 1.2MB floppy disk drive, LIM 4.0, \$6,696; with 8MB RAM, 322MB hard disk, 1.2MB and 1.44MB floppy disk drives, Super VGA color display subsystem, DOS 3.31, \$10,725.

In Short: The SIA 486/33 is an impressive if expensive file server or CAD station. It combines blazing processor speed with good expansion capabilities, particularly where disk drives are important.

CIRCLE 546 ON READER SERVICE CARD

TANGENT COMPUTER INC.

Tangent 433i

by Edward Mendelson

Built from standard components, Tangent Computer's sleek and sturdy mail-order Tangent 433i sells for \$6,690. That price includes 8MB RAM, 128K of processor RAM cache, a 200MB Maxtor IDE hard disk, a 1.2MB floppy disk drive, and an Orchid ProDesigner II Super VGA video adapter and Sony 1304 multiscanning monitor, plus one parallel and two serial ports, a game port, and DOS 4.01. You can save \$500 if you get the machine configured with an Orchid ProDesigner E VGA card and standard VGA monitor. If you're really trying to save pennies and you're willing to plug in your own hard disk, video card, and monitor, you can buy a 1MB-equipped unit for \$3,490.



Tangent 433i
Tangent Computer
Inc., 197 Airport
Blvd., Burlingame,
CA 94010; 800-223-
6677, 415-342-
9388

List Price: With
1MB RAM, 128K
RAM cache, 1.2MB
floppy disk drive,
one parallel and two
serial ports, game
port, tower case,
\$3,490; with 8MB
RAM, 200MB hard disk, Super VGA color
display subsystem, DOS 4.01, \$6,690.

In Short: The Tangent Model 433i is a
reasonably priced mail-order machine,
considering its high-quality components. The
two-year warranty is a noteworthy bonus.

CIRCLE 547 ON READER SERVICE CARD

The system's tower case gives you six half-height bays, all accessible from the front panel. Below the drive bays are the standard array of power switch, turbo switch, keyboard lock, and indicator lights.

Tangent's motherboard, made by Advanced Integration Research with a Chips and Technologies chip set and AMI BIOS, has sockets for 16 SIMM chips with capacities of 256K or 1MB; our tested machine came with eight 1MB SIMMs rated at 70 nanoseconds. The 128K of processor RAM cache, controlled by discrete logic circuitry, is standard on the board; you can't order less and you can't install more. A switch bank on the motherboard lets you turn the processor RAM cache on or off.

You get eight 16-bit expansion slots on the 10-MHz bus. Tangent sensibly routes the two serial ports from the I/O card to



Tangent 433i, \$6,690

COVER STORY 33-MHz 486 PCs

extra openings on the back of the case. Although Tangent installed a 200MB Maxtor IDE hard disk in our tested machine, the IDE connector is not on the motherboard but on a small expansion board plugged into one of the motherboard slots. An IDE connector and floppy disk controller on the motherboard would have saved a slot, but as in many 486 models, the motherboard looks too crowded to support the extra circuitry.

STANDARD PERFORMANCE, SOLID WARRANTY

When the Tangent 433i arrived at PC Magazine Labs, the I/O card had slipped partly loose from its slot, and the machine wouldn't boot until we opened the case and seated it firmly. Once we got past this

If you like having a
full range of choices,
checking out the
Tangent 433i may be
worth your while.

minor hiccup, the computer performed solidly and reliably throughout our testing process.

The Tangent 433i performed near the low end of the range on our processor and memory benchmark tests but near the high end on disk and video tests. Yet all the machines in this roundup were so closely ranked that the differences are hardly worth considering.

Tangent Computer provides a two-year warranty on both parts and labor. For certain problems, that warranty can include on-site service by TRW, at Tangent's discretion.

Tangent can customize its systems to meet almost any user specification. For instance, the company can supply a full range of Orchid VGA and DFI mono-chrome cards with monitors to match; and if you don't want an IDE drive, it can sell you ESDI or SCSI drives ranging from 360MB through 1GB. If you like having a full range of choices, checking out the Tangent 433i may be worth your while.

TRI-STAR COMPUTER CORP.

Flash Cache 486

by Kellyn S. Betts

Tri-Star Computer Corp.'s Flash Cache 486 looks huge; its carrying handles and wheels make the machine appear larger than its 24.3- by 8.8- by 19.3-inch size. But if this tower system looks imposing, its list price isn't. Equipped to meet our standard configuration, with 8MB of RAM, a 64K RAM cache, a 200MB Maxtor hard disk, 1.2MB and 1.44MB Mitsumi floppy disk drives, an STB Super VGA adapter and 14-inch ViewSonic 4 Super VGA monitor, one parallel and two serial ports, a 101-key Nan Tan keyboard, and DOS 4.01, it costs a low \$6,235.

In its basic configuration, the Flash Cache 486 costs \$4,500 including 4MB of RAM and a 65MB hard disk. For CAD users, Tri-Star will be offering a package deal called Tri-CAD; its price was not available when this review was written. The package is to include a basic system with a 12- by 12-inch cordless digitizer and a high-resolution 16- or 20-inch monitor and adapter.

The Flash Cache 486's components seem dwarfed by the amount of available space inside the case. The relatively small AMI motherboard features VLSI as well as discrete logic chips and an AMI BIOS, and it has a socket for a Weitek 4167 math coprocessor. The 64K processor RAM cache in our tested system was made up of 15-nanosecond DIPs.



Flash Cache 486
Tri-Star Computer
Corp., 707 W.
Geneva Dr., Tempe,
AZ 85282; 800-678-
2799, 602-829-0550.

List Price: With
4MB RAM, 64K
RAM cache, 65MB
hard disk, 1.2MB or
1.44MB floppy disk
drive, Super VGA
adapter, ViewSonic
4 Super VGA color
monitor, one parallel
and two serial ports, DOS 4.01, \$4,500; with
8MB RAM, 200MB hard disk, 1.2MB and
1.44MB floppy disk drives, \$6,235.

In Short: This tank-like machine looks more
powerful than it actually is. It has promise as a
high-capacity workhorse, with the speed you'd
expect from one.

CIRCLE 548 ON READER SERVICE CARD

Here's what they're saying about Ami Pro from Lotus.

“Independent User Survey For Windows.^{TM*}”

Word Processing Features	Ami Pro <i>for Windows</i>	Word for Windows	WordPerfect for DOS
Best Overall	50%	22%	16%
Ease of Learning	47%	28%	8%
Ease of Use	52%	23%	8%

*Independently commissioned Windows word processor Usage and Attitude Study conducted November 1990

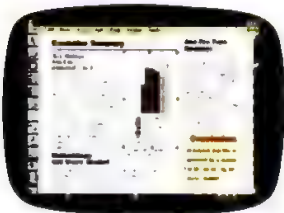
Here's why th



WYSIWYG

No wonder Ami Pro™ for Windows™ is getting rave reviews from users.* They're naturally impressed by its 360 powerful features. And even more impressed with how

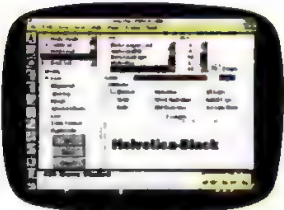
easy it is to use them. Ami Pro has everything you expect in a power word processor, plus important features you can't find anywhere else—like truly interactive WYSIWYG that lets you edit in any of four page views, including full-page view.



FRAMES

Our exclusive "frames" feature lets you quickly place text and graphic elements where you want. Just position your frame anywhere on the page, then fill it with words,

drawings or imported graphics. With a click of the mouse, your text automatically wraps around it.



DIALOG BOXES

Why settle for difficult programs that produce boring documents? Our friendly, interactive Dialog Boxes display all your layout options—and show you the results of

commands before you execute them. So you can change your mind without wasting time.



CHARTS AND GRAPHS

In addition to a built-in drawing feature, Ami Pro instantly generates 168 varieties of presentation-quality charts and graphs, including 2-D, 3-D and perspective. Just type

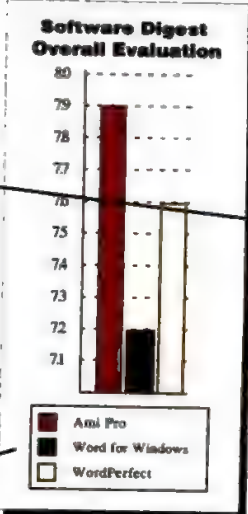
in the data, or import your chart information from programs like Lotus® 1-2-3.*

User Study Matches Expert Reviews

User preference research findings have an uncanny resemblance to what word processing and technology experts have been saying all along: Ami Pro is the new standard for word processing in the Windows environment.

The Software Digest rating, for example, places Ami Pro well above Microsoft's Word for Windows and WordPerfect in terms of overall performance.

The user research shows similar results. Ami Pro consistently outranked Word for Windows and WordPerfect in terms of



USER PREFERRED WORD PROCESSOR

Executive Summary

Key findings:
Ami Pro preferred 2 to 1

Users prefer Ami Pro from Lotus more than 2 to 1 over Microsoft Word for Windows and WordPerfect. Half of the users studied ranked Ami Pro as the "Best Overall" Windows word processor and the overall word processing product. 51.9% said Ami Pro was easier than Word for Windows and WordPerfect; 47.5% said it was easiest to learn.

A whopping 63% said they are extremely enthusiastic about the product or like it better than

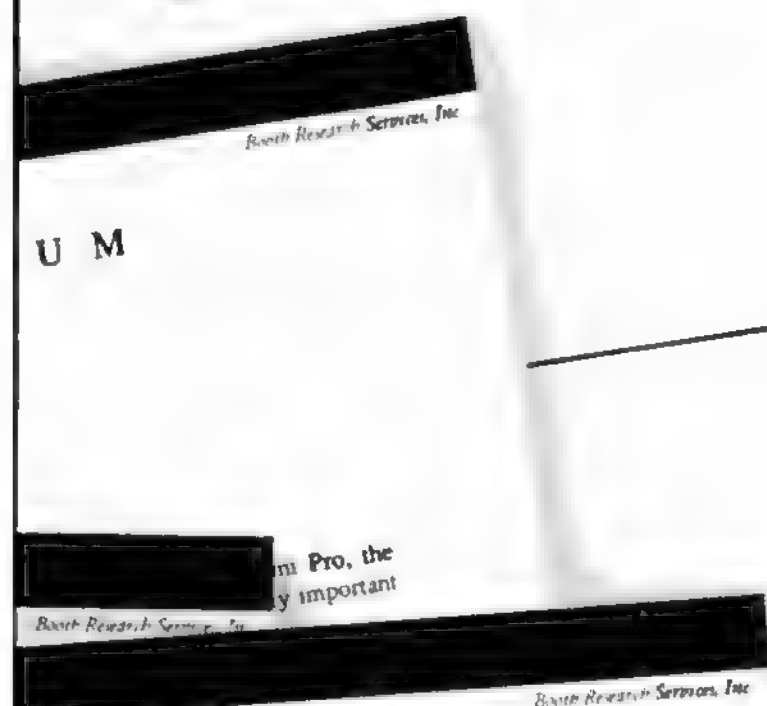
Methodology: 42

This independent study was conducted in November, 1990. A random sample of processing users were called to determine attitudes and user experience.



Easiest to Use

They're saying it.



STYLE SHEETS

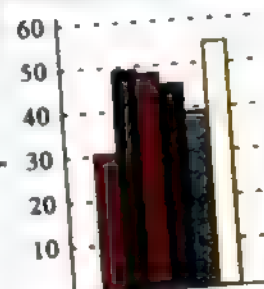
Ami Pro comes with more than two dozen style sheets that have the page layout already set up and ready to go. So you can produce professionally designed business letters, memos, reports, presentations, newsletters and more—in just the time it takes to type in text.

REFERENCE STUDY: PUBLISHING FOR WINDOWS

Ami Pro Tops Rankings

Ami Pro came out on top on nearly all of the 17 characteristics ranked by users. An impressive 51.9% of the respondents rated Ami Pro easiest to use, while a whopping 56.5% gave Ami Pro top consideration for "Formatting Flexibility."

Although not cited in this chart, users also ranked Ami Pro as tops in desktop publishing (60.3%), and in getting the most out of Windows (41.2%).



Conclusion:

In general, Ami Pro is preferred by a margin of 50% to 52% by all users studied.

Users Studied

Used over a three week period in a survey of more than 1,000 word processing interviews on preference.

FEATURES COMPARISON

Feature	Ami Pro	Word for Windows	WordPerfect 5.1
Interactive WYSIWYG	Yes	Yes	No
On-Screen Font and Attributes	Yes	Yes	No
Auto Text Wrap Around Graphics	Yes	No	Yes
Editable View Levels	Yes	No	No
Global Style Sheets	Yes	No	No
Thesaurus Offers Word Meanings	Yes	Yes	No
Visual Dialog Boxes	Yes	No	No
Internal Chart Generation (10 Types)	Yes	No	No



EXPERTS AGREE

It's easy to see why users prefer Ami Pro from Lotus two to one over Microsoft® Word for Windows™ for overall features and ease of use. And why it's received top ratings from virtually all the industry experts, racking

up such coveted awards as PC World's Best Buy. The Buyers Assurance Seal from InfoWorld. And PC Magazine's Editor's Choice.

"Ami Pro received a score in Ease of Use of the User Interface that was fully 10 points higher than the next highest score, and came in 14 points ahead of the score WordPerfect™ 5.1 drew from its buyers," according to PC Week's Corporate Satisfaction Poll.

PC Magazine says, "Ami Pro has the friendliest interface and the widest range of functions...[It] is easier to use than almost any program with comparable powers."**

Ami Pro is the word processing program that takes full advantage of the Windows environment, combining power word processing with the power to create professional documents fast. And with its icons and interactive features, Ami Pro is incredibly easy to learn and use. So what do you say? You've just learned about five major Ami Pro features.

Now to find out about the other 355—and how to get a great upgrade offer—turn the page.

This says it all.

Automatic Backup Automatic Timed Save

Block Manipulation Bookmarks

• Named By User • Go To

Charting

• 3D Charting • Edit Chart with Draw Tools
• Legends • Multiple Styles Per Type • 7 Chart Types

Copy Text and Graphics

Cursor Movement

• Begin/End of File • Character • Line • Page
• Paragraph • Sentence • Top/Bottom of Screen • Word

Customizable Icon Bar

• Choose From Over 45 Functions • Quick Access to Features

Customizable View Level

• 10-400% • Fully Editable

Cut and Paste

Date Insertion

• Today's Date • Date Printed • Date Last Edited • Definable Style

DDE (Dynamic Data Exchange)

• Two-way • Paste Link • Text and Graphics
• Via Macro Language

Defaults

• Backup Options • Date Styles • Dictionary Paths • Display Options • Document Path
• Draft Mode Colors • Footnote Options
• Hyphenation Hot Zone • Pair Kerning • Printer
• Icon Bar Icons • Undo Levels • View Level

Delete

Dialog Boxes

Document Annotation

• Notes • Show/Hide • Go To Notes • Date/Time Stamp • Stacked Notes

Document Descriptions

• Author Name • Operator Name • Revision Number • Creation Date • Revision Date
• Renameable Fields • User Defined Fields
• Display with Directory • Print with Document

Drawing

• Cut/Paste Objects • Circles • Arcs • Squares
• Rectangles • Rounded Boxes • Diagonals
• Polygons • Polylines • Group Objects
• Snap-To Grid • Fill Patterns • Line Widths
• Text Rotation • Type Text

File Import/Export

• AdvanceWrite • ASCII • DBase • DCA Final Form • DCA Revisable Form • DIF • E-Mail
• Enable • Lotus WKS, WK1, WK3 • Microsoft

Word • Microsoft Word for Windows • Multimate • Navy DIF • Peachtext • Rich Text Format • Samna Word • Windows Write • WordPerfect • WordStar • Wordstar 2000

File Management Functions

• Copy • Rename • Delete • Move • Sorted File Listing

Font Control

• Unlimited Number of Fonts • WYSIWYG
• Limited Only by Printer

Footnotes

• Auto Numbering • Bottom of Page • Endnotes • Number Style Option • Reset Number Option • Separator Line

Forms Capability

• Format Complicated Forms • Fill-In On-Screen
• Print on Preprinted Form • Protect Areas

Frames

• Anchor to Text • Auto Text Wrap Around
• Background Shade • Contain Text or Graphics • Fixed Position On Page • Lines Around • No Text Wrap Around • No Text Wrap Beside • Overlay Frames • Repeat on Multiple Pages • Resize Frames

Glossary

• Large Record Size • Speed Key Access

Go To

• Any Page Number • Fast Next Item Access
• Go To Frame, Footnote, Note, Various Marks in Document

Graphics Control

• Edit PIC Files • Drop Anywhere on Page
• Float Graphic w/Text • Place in Box • Proportional Scaling • Fit in Frame • Rotate in Single Degree Steps • X-Y Scaling • Gutter/Binding Margins

Graphics Import

• CGM • EPS • HPGL • Lotus PIC • PCX
• TIFF • WMF

Hard Space

Headers/Footers

• Alternating • Floating

Help

• CBT Tutorial Available • Context-Sensitive
• Indexed • Point & Shoot • Hypertext Linked
• Full Macro Documentation On-Line

Hyphenation

• As-You-Type • Soft Hyphen • Consecutive Hyphen Control • On Paragraph Basis • Hot Zone

Image Processing

• Control Brightness, Contrast of Scanned, Gray Scale TIFF Pictures • Sharpen Edges

• Smoothing • Invert Image

Index Generation

• Generate from List • Mark in Text • Multiple Level Indexing • Hyper Links from Index Back into Document

Insert/Typeover

Kerning

Line Numbering

Line Spacing Control

Macros/Programming Language

• On-Line Macro Documentation • Record/Play • Assign to Function Key • Assign to Menus • Create Menus • Variables • If • Go To Statements • Case Statements • For/Next
• Prompt for Input • Subroutines

Math Calculations

Measurements

• Centimeters • Inches • Picas • Points

Merge

• From ASCII Files • From Comma Delimited Files • From DIF Files • From WK* Files • From dBase Files • From Ami Pro File • Label Print Function • Preview Before Print • Three-Level Boolean Conditional Record Inclusion

Open Multiple Documents

Page Breaks

• Manually Inserted • With Paragraph Style

Page Formatting Control

• Margins • Page Size • Sneaking Columns
• Line Around Page • Line Between Columns
• Portrait/Landscape

Page Numbers

• Any Location on Page • Reset Page Number
• Five Formats for Number

Paragraph Styles

• Quick Access with Styles Box • With Function Key • Controls: Font, Alignment, Spacing, Page Breaks, Ruling Lines, Bullets, Numeric Format in Table, Hyphenation

Printing Color

Print Options

• Over 130 Printers Supported • Number of Copies • Page Range • Reverse Order
• Collate • Print Document Description • Crop Marks • On Preprinted Form • Printer Bin Control for First/Rest Pages • Portrait or Landscape

Real-Time Pagination

Revert to Saved Version

Search and Replace

• Case Insensitive • Forward or Backward
• Header/Footer/Footnote • Skip • Replace

• Replace All • Search for Style • Search by Attribute • Wildcards

Section Outline Numbering

• 8 Levels • Number Paragraphs • Numbered Lists • User-Defined Reset

Sneaking Columns

• Up to 8 Columns • Column Balancing • On Screen • Variable Width • Variable Spaced

Sort

• Alphabetic • Numeric • Ascending • Descending • By Paragraph • By Word • By Number of Lines • 3 Levels—3 Words Within each Level

Spelling Check

• 130,000 Word Dictionary • Add to Dictionary
• Correct Multiple Occurrences • Entire Document • Selected Text • International Dictionaries • Rest of Document • Skip All Occurrences • Statistics Report • Unlimited User Dictionary Size

Status Line

• Column Number • Document Name • Insert/Typeover • Line Number • Page Number

Style Sheets

• 27 Professionally Designed • Control All Formatting in Document • Document-Only Styles • Global Styles

Tables

• Up to 256 Columns • Column Width Control
• Row Height Control • Auto Row Height
• Lines around Cells • Shaded Cells • Connected Cells • Formulas: Four-Function Math, Sum Function, Absolute/Relative Cell Address
• Insert Rows and Columns • Numeric Alignment and Formatting

Table of Contents

• 3 Levels • Separator Choice

Tabs

• Center • Leader Dot • Left • Numeric • Right

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• Lowercase • Overstrike • Small Caps • Subscript • Superscript • Underline • Uppercase
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Flash Cache 486. \$6,235

The system board can hold up to eight rows of 80-ns. 1MB SIMMs; you can boost system memory by as much as 8MB with an optional add-in board that fits into a proprietary 32-bit slot. This 16MB maximum may be sufficient for most uses, but it's probably less than you'd expect from such a hulking machine.

The Flash Cache 486 offers as many drive bays and free expansion slots as you might want. Six 16-bit slots were open in our test system. The machine also has ample room for drives, providing five half-height and three full-height bays. The largest-capacity drive that Tri-Star offers is 200MB, which again is smaller than you'd expect.

The system includes a two-year parts-and-labor warranty and a 60-day money-back guarantee. And while the manuals have a photocopied feel, they're vastly better than the collections of component manuals offered with many of the machines we reviewed in this roundup.

If you're looking for portability, this system's wheels and carrying handle should make it easy to pull down long hallways. A respectable if not outstanding performer on our benchmark tests, the Flash Cache 486's price and reasonable expandability make it a worthwhile choice.

TWINHEAD CORP.

Twinhead Superset 600/433

by Kellyn S. Betts

If there were a competition for the smallest 33-MHz 486, the Twinhead Superset 600/433 would certainly be a contender.

COVER STORY 33-MHz 486 PCs

This small-footprint machine may not offer the kind of expansion space you would need in a file server, but it could nonetheless make a fine personal workstation.

The Superset 600/433's price puts the machine within the reach of many power users. For \$6,225, the cost of our standard configuration, you get 8MB of RAM, a 64K processor RAM cache, a 16-millisecond 204MB Conner hard disk, a 1.2MB floppy disk drive from Canon or a 1.44MB model from TEAC, a Super VGA adapter, a Relisys Super VGA monitor, one parallel and two serial ports, a 101-key keyboard, and DOS 4.01. Our tested unit came with two floppy disk drives and bore a list price of \$100 more. In its basic configuration, the machine lists for \$5,495 but includes 4MB of RAM, a 100MB hard disk, a Super VGA chip set on the motherboard, and a Super VGA color display system.

Twinhead outfits the Superset 600/433 in an attractive, sturdy 5.8- by 15.8- by 15.8-inch case—the same little chassis it uses for four other 386- and 486-based computers in the Superset 600 line. In fact, the only thing that differentiates the 600/433 from the other models is its processor card, which Twinhead calls a Power-Card. To upgrade one of these systems, you simply fit a different card into the proprietary Power-Slot in the center of the chassis.

In addition to holding the 486/33 chip,



Twinhead Superset 600 433. \$6,325

the Power-Card has the 64K processor RAM cache, which uses a proprietary controller. The cache in our evaluation unit consisted of 25-nanosecond SIMMs. The motherboard uses a Chips and Technologies chip set and a Phoenix BIOS, and it is also host to such critical components as a 16-bit Paradise Super VGA chip set and Western Digital floppy and hard disk controllers.

This small-footprint machine's layout has been carefully planned. The processor card stands in the same plane as the four 16-bit expansion slots in the computer's passive backplane, parallel to the 3.5-inch drive bay housing the system's 204MB Conner hard disk. Next to the hard disk are the Superset 600's three other bays: one half-height and two one-third-height.

The system comes with an excellent, well-illustrated manual and is backed by an industry-standard one-year warranty. On-site service is provided by Nationwide Warranty Company.

The fact that it contains but four expansion slots and four bays limits the Superset 600/433's functionality as a file server, but it should suffice as a personal workstation. Another shortfall could be the system's performance, which, though respectable, was generally in the bottom half of the pack on our benchmark tests.

These qualms aside, the Twinhead Superset 600/433 is small but mighty. It's a polished system that is just right for a desktop. ■

Kellyn S. Betts is a New York-based freelance writer. Bruce Brown, Edward Mendelson, Bill O'Brien, and M. David Stone are contributing editors of PC Magazine. Fredric Burke is a frequent contributor to PC Magazine. ■

FACT FILE

Twinhead Superset 600/433
Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; 800-545-8946, 408-945-0808.
List Price: With 4MB RAM, 64K RAM cache, 100MB hard disk, 1.2MB or 1.44MB floppy disk drive, Super VGA color display subsystem, one parallel and two serial ports, DOS 4.01, \$5,495; with 8MB RAM, 204MB hard disk, Super VGA video adapter, Relisys TH-1401S Super VGA monitor, \$6,225; with both floppy disk drives, \$6,325.
In Short: If you need a small-footprint machine, Twinhead packs a lot of wallop into a very small package. Future machines from the company should function better in the server role.

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Memory: 1MB memory standard, expandable to 5MB.

Storage: 1.44MB, 3.5 inch, high density, double sided diskette drive. 40MB IDE hard drive.

Keyboard: 82 key layout emulates 101-key keyboard with embedded keypad and 12 function keys; system supports external keyboard and external 10-key keypad.

Video: Built-in VGA monitor adapter. Dual panel EL backlit monochrome VGA liquid crystal display. I/O port to support external VGA monitor.

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Storage: 1.2 MB, 5.25 inch, high density, double sided diskette drive, OR 1.44MB, 3.5 inch, high density, double sided diskette drive. 110MB IDE hard drive.

Keyboard: 101-key enhanced layout.

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\$1,999

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Memory: 1MB memory standard; expandable onboard to 5MB. 16MB system maximum. (With expansion board.)
Storage: 1.2MB, 5.25 inch, high density, double sided diskette drive. OR 1.44MB, 3.5 inch, high density, double sided diskette drive. 40MB IDE hard drive.
Keyboard: 101-key enhanced layout.
Video: 16-bit VGA adapter with 256KB RAM, expandable to 512KB. 14 inch VGA monochrome display.
Leasing: As low as \$113/month.



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STANDARD CONFIGURATION

Microprocessor and Main Board: Intel 80486 running at either 8 or 25 MHz.
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Storage: 1.2MB, 5.25 inch, high density, double sided diskette drive. OR 1.44MB, 3.5 inch, high density, double sided diskette drive. 110MB IDE hard drive.
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Storage: 1.2MB, 5.25 inch, high density, double sided diskette drive. OR 1.44MB, 3.5 inch, high density, double sided diskette drive. 200MB IDE hard drive.
Keyboard: 101-key enhanced layout.
Video: 16-bit VGA adapter with 256KB RAM, expandable to 512KB. 14 inch VGA monochrome display.
Leasing: As low as \$182/month.



Tandon Tower 386/33

\$4,999

STANDARD CONFIGURATION

Microprocessor and Main Board: Intel 80386 running at either 8 or 33 MHz. Main board has socket for Intel 80387 or Weitek 3167 math coprocessor.
Memory: 4MB standard memory, expandable to 16MB of 32-bit memory.
Storage: 1.2MB, 5.25 inch, high density, double sided diskette drive. AND 1.44MB, 3.5 inch, high density, double sided diskette drive. 200MB IDE hard drive.
Keyboard: 101-key enhanced layout.
Video: 16-bit VGA adapter with 256KB RAM, expandable to 512KB. 14 inch VGA monochrome display.
Leasing: As low as \$143/month.



Tandon Tower 486/33 EISA

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Microprocessor and Main Board: Intel 80486 running at either 8 or 33 MHz. Main board accepts a Weitek 4167 coprocessor to coexist with the 80486's built-in math coprocessor.
Memory: 4MB memory standard; expandable to 64MB of 64-bit memory.
Storage: 1.2MB, 5.25 inch, high density, double sided diskette drive. AND 1.44MB, 3.5 inch, high density, double sided diskette drive. 200 MB IDE hard drive.
Keyboard: 101-key enhanced layout.
Video: 16-bit VGA adapter with 256KB RAM, expandable to 512KB. 14 inch VGA monochrome display.
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- Coprocessors
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IN THE GRAND TRADITION THE LEANING TOWER, AND INTRODUCING THE TAND

Now the world can look up to yet another impressive tower. At \$7699, the Tandon Tower 486/33 EISA is ideal as a local area network server, departmental computer, or multi-user platform. It operates at a blistering 33MHz, comes with 4MB of RAM, and makes for a commanding presence sitting next to your desk.

Tandon engineers, with over 16 patents to their credit, designed the Tandon Tower 486/33 around the top of the line Intel® 80486 processor. This makes it perfect for multitasking, complex graphics, and large spreadsheets.

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Yet with all these features, there's still room to grow. The Tandon Tower 486/33 can be upgraded to 64MB of 64-bit memory. And because networking requires massive amounts of data storage, it has eight half-height drive bays and accepts hard drives of up to 1 gigabyte.

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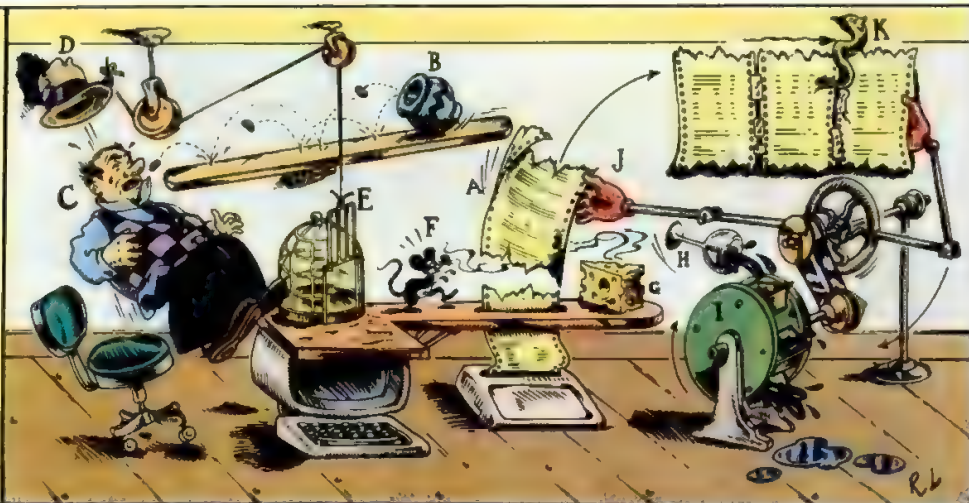
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RISING SPREADSHEET (A) KNOCKS MEXICAN JUMPING BEANS (B) INTO MOUTH OF NEUROTIC MAN (C) WHO IS SO DISCOMBOLATED THAT HIS HAIR STANDS ON END, DISLORGING HAT (D) WHICH OPENS CAGE (E) AND RELEASES EPICUREAN MOUSE (F).

MOUSE, INSPIRED BY SCENT OF PERFECTLY AGED CAMEMBERT CHEESE, GNAWS THROUGH SPREADSHEET, ONLY TO DISCOVER HE HAS BEEN FOOLED BY AROMA OF OVER-RIPED GORGONZOLA (G).

IN A FIT OF PIQUE HE SPILLS VINTAGE WINE (H) INTO WATER-WHEEL (I) WHICH TURNS PULLEY THAT CAUSES GLOVE (J) TO GRASP SPREADSHEET AND MOVE IT TO TAPING AREA.

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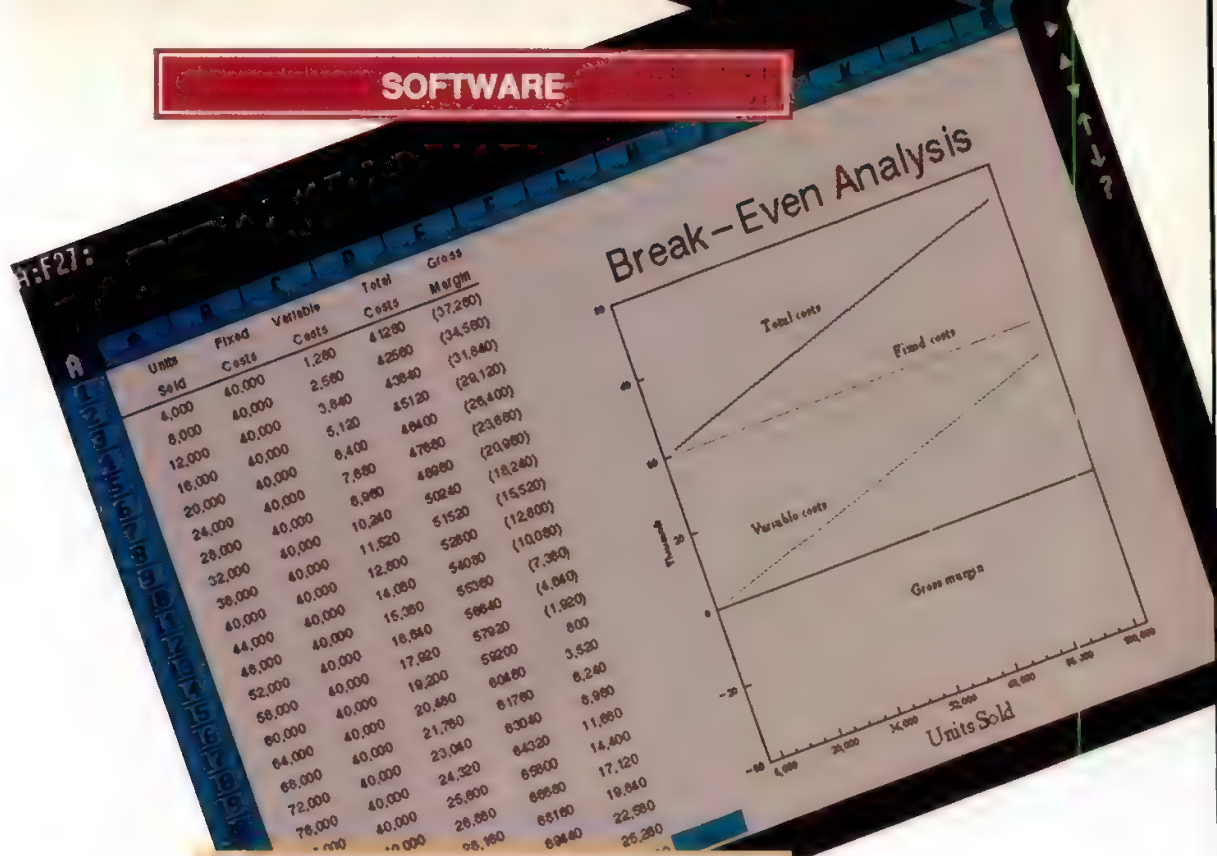
**FUNK
SOFTWARE**

Funk Software, Inc., 222 Third Street, Cambridge, MA 02142

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Should you upgrade
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1-2-3

RELEASE

3.1

GRAPHIC IMPROVEMENTS

by Craig Stinson

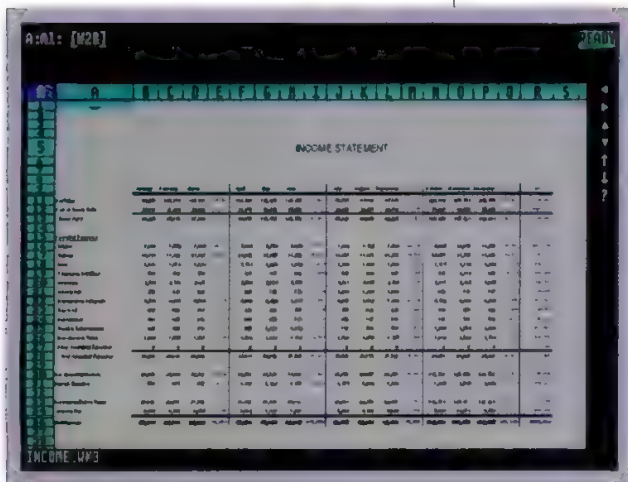
One of the ironies surrounding the two-tiered upgrade of *Lotus 1-2-3*, Release 2.01, in the summer of 1989 was that the minor upgrade, Release 2.2, proved to be superior to the major one, Release 3.0. Release 3.0 featured three-dimensional worksheets, sophisticated file-linking, improved graphics, and advanced data-management capabilities. But Release 2.2, pitched as a "consolation" for those who couldn't meet Release 3's hardware requirements, boasted

SOFTWARE LOTUS 1-2-3, RELEASE 3.1

Figure 1:
You can create this
vertical window
simply by dragging
the mouse
horizontally across
the screen.



Figure 2:
Wysiwyg's Display
command can be
used for panoramic
overviews and
intimate closeups.



superior recalculation and screen-update performance, handy setting sheets for graphs, sorting, querying, and printing, and a better macro-trace facility. Most important, however, was *Always*, a bundled publishing add-in that let users turn spreadsheets into presentable reports, complete with fonts, borders, and shading.

With the arrival of the \$595 *Lotus 1-2-3*, Release 3.1, Lotus has closed the embarrassing publishing gap between its two DOS spreadsheets. This newest release comes bundled with *Wysiwyg*, a slightly modified version of PC Publishing's *Im-*

press. Like *Always*, *Wysiwyg* is a publishing add-in, but it does much more than *Always*.

With the strength of *Wysiwyg*, Lotus can now claim to have the strongest spreadsheet publisher in the market—more versatile than *Quattro Pro* (although weaker in certain respects) and superior to the aging *Microsoft Excel*, Version 2.1. The claim may be short-lived, of course. All major spreadsheet vendors, Lotus included, are striving to get new versions for *Microsoft Windows* out the door, and it's a sure thing that glorious, easy-to-produce products will be high on everybody's list of design goals. But meanwhile, *Lotus 1-2-3* Release 3.1, is the premier publisher of the spreadsheet world.

A PUBLISHER— AND MORE

Wysiwyg was designed from the start to be an *Always* killer—an add-in that would allow *1-2-3* users to adorn worksheets with fonts, typeface styles, lines, borders, and shading, with more power and flexibility than *Always*

offered. *Wysiwyg* has met that goal, but it also does several other important things: It provides an optional mouse interface

for *1-2-3*, it gives you much broader control over the appearance of your screen, and it allows you to format your worksheet while you build it. *Always* requires you to work in one display mode (*1-2-3*'s normal text screen) while you build your worksheet, and then switch to a different one (the *Always* graphics screen) to assign formatting attributes.

Wysiwyg's mouse interface can be used for choosing commands, scrolling, navigation, selecting cells and ranges, setting column widths and row heights, and creating screen windows. Even if you're an eight-year veteran when it comes to typing *1-2-3* command sequences, you'll probably find the mouse handy for some of these activities.

With *Wysiwyg* installed, you'll be choosing commands from two distinct menu trees: those found in *1-2-3* and *Wysiwyg*. To get to a *1-2-3* command, you type the /key, as you always have. To pick a *Wysiwyg* command, you start by pressing the colon key (:). With the mouse, though, you can summon either menu system just by pointing. As soon as you move the pointer into the area above your worksheet, the last menu tree used pops up. To choose a command, you click with the left button; to toggle the other menu tree into place, you click with the right.

When you choose *1-2-3*'s /File Retrieve command, *Wysiwyg* displays disk and directory symbols on the top line of the screen. This procedure circumvents the clumsy keyboard rituals imposed by *1-2-3* for retrieving a file from a nondefault directory. After you've navigated to the drive and directory of your choice, you can click the word List to get a full-screen listing of .WK* files.

If you're new to Release 3, you'll probably find the mouse a boon for moving between the pages of your 3-D worksheets or from one open file to another. Release 3's keyboard steps for these actions are a logical outgrowth of the Release 2 navigational sequences, but they're still troublesome to master. With *Wysiwyg* and a mouse, you can travel through memory just by clicking arrows on the right side of the current worksheet.

Splitting the screen into windows is also easier with the mouse. You simply click on the worksheet letter in the upper-left-hand corner of the frame and drag it to the right or downward (see Figure 1). A similar kind of "direct manipulation" lets you change column widths and row heights without traversing the menu tree.

Finally, if you're accustomed to building formulas in POINT mode, you may find it quicker to point with the mouse than with the keyboard. Here, though, you'll incur the tradeoff of having to lift your hand from the keyboard while in the middle of typing a formula.

WHAT YOU SEE IS WHAT YOU PLEASE

Even if you never need boardroom-quality printing, you may find *Wysiwyg* a valuable screen utility. Provided you have a VGA, EGA, or Hercules display (or a system that can emulate one of these), you can tailor *Wysiwyg* to display as much or as little of your worksheet as you need at any given moment. Commands on the :Display Zoom menu let you apply a scaling factor from 25 to 400 percent to the horizontal and vertical aspects of your screen, while the Rows command lets you modify the vertical dimension only. Figure 2 shows a worksheet scaled to display 38 rows by 19 columns.

With other Display menu commands, you can enable, disable, and modify various elements of the *Wysiwyg* screen. If you like grid lines, for example, turn them on. If the dotted lines that indicate automatic page breaks distract you, turn them off. If you want to conceal your spreadsheet, you can use a menu command to suppress the column-and-row-heading frame.

The frame itself can be modified to show ruler markings instead of row-and-column identifiers. If you want to know how much space a worksheet will occupy on printout, for example, you can change the grid to display inches, centimeters, picas, or ten-pitch characters. You'll also find this feature useful for balancing space in ruled forms (see Figure 5) or if you need to leave room for a piece of clip art.

Those with color printers will particularly appreciate *Wysiwyg*'s range of color-setting options. By default, the program displays a cyan frame, a low-intensity white background for the worksheet, and black text, but you may apply any of the eight colors to the following display elements: the worksheet background, text and numbers, unprotected cells, the cell pointer, grid lines, the worksheet frame, negative numbers, lines and borders, and drop shadows. You can also override the current color setting for the contents of any particular cell (even for particular characters within a cell), and reverse the foreground and background shades of particular cells.

Fortunately, there's also a command to restore all current default settings in case you create a complete mess and can't find your way back. Unfortunately, the program provides no convenient way to create named and reusable combinations of default settings. A settings sheet for global formatting defaults would also be a welcome addition to *Wysiwyg*.

GRABBING ATTENTION

From the standpoint of appearances, the single most primitive aspect of 1-2-3 has undoubtedly been its lack of underscoring capability. For years, the 1-2-3 user has had only one way to separate headings and totals from the content within: insert rows, hyphen fills, or equals signs. If you do nothing fancier with *Wysiwyg* than use its :Format Underline command, you'll at least make your reports look like they came off a computer, rather than a typewriter. Figure 3 shows a sample of *Wysiwyg*'s hairline, thick, and double underscoring. (Note that the underscores generated by :Format Underline are automatically fitted to the width and position of the underscored text. For creating lines that fill the width of a cell, *Wysiwyg* offers a different set of commands, on the :Format, Lines menu.)

Like underscores, cell-filling lines come in three styles—hairline, double, and thick. Figure 4 shows examples of all three, as well as illustrating the use of *Wysiwyg*'s drop-shadow feature. Drop shadows are most commonly used to make headings stand out in three-dimensional relief. But they can also be an effective way to call attention to the bottom line and other noteworthy worksheet regions. Unlike *Allways* and *Excel*, *Wysiwyg* generates shadows with

Figure 3:
The simple commands for underscoring can improve visual impact and eliminate the need for hyphens.

	Q1	Q2	Q3	Q4	TOTAL
Payroll	4,200.00	5,320.00	4,480.00	7,140.00	21,140.00
Utilities	3,150.00	3,960.00	3,360.00	5,355.00	15,865.00
Rent	1,400.00	1,400.00	1,810.00	1,810.00	6,420.00
Ads	1,680.00	2,128.00	1,782.00	2,856.00	8,450.00
COG Sold	7,350.00	9,310.00	7,840.00	12,356.00	36,856.00
Total Operating Expenses	17,780.00	22,148.00	19,082.00	29,456.00	88,466.00

Figure 4:
Wysiwyg offers rules in three weights, and includes automatic drop shadowing.

	1989	1990	Projected 1991	Projected 1992
Sales	\$95,000	\$120,800	\$154,031	\$185,948
Production Costs				
Labor	\$22,778	\$28,770	\$38,412	\$51,428
Materials	\$49,585	\$62,737	\$75,811	\$91,377
Overhead	\$880	\$1,000	\$1,063	\$1,110
Total Cost of Goods	\$73,343	\$92,507	\$115,286	\$143,915
Gross Margin	\$21,657	\$28,293	\$38,845	\$42,033
Operating Expenses				
Research and Development	\$480	\$523	\$810	\$1,057
General Administrative	\$1,800	\$2,288	\$2,771	\$3,368
Sales and Marketing	\$2,877	\$3,558	\$4,571	\$5,728
Total Operating Expenses	\$5,157	\$6,369	\$8,152	\$10,153
Operating Income	\$16,499	\$21,924	\$30,693	\$31,880

SOFTWARE LOTUS 1-2-3, RELEASE 3.1

Figure 5:
Changing the worksheet frame to display inches, centimeters, or picas can help you lay out simple ruled forms such as this billing statement.

Alt: {OUTCM24 Bold Italics M3 Text} [M3] Wee Groem Nursery

Top phone: 718 555-1210 (717) 555-1234 7800 Corporate Blvd. Pasadena, CA 91109

DATE	DESCRIPTION	CHARGES	CREDITS	BALANCE
			BALANCE FORWARD	210.50
11/29	INVOICE #9045612	51.20		261.70
12/03	INVOICE #9048129	107.85		369.55
12/10	Check received -- Thank you!		210.50	159.05
12/18	INVOICE #9052154	18.28		177.33
THANK YOU!				

All accounts due on the 10th of the month following date of service
2% interest per month will be charged on accounts over 60 days

Pay Last Amount Above

WEADEN.UK3

a simple menu command.

Each of the lines in Figure 4 is drawn beneath a range of cells and is used to separate one functional worksheet area from another. You can also use commands on the :Format Lines menu to produce vertical separators and boxes. And if the hairline and thick styles don't produce the effect you want, you can fill blank rows or columns with "solid" shading. By adjusting the width of shaded columns or the height of shaded rows, you can achieve solid separators of any weight you please.

Figure 5 shows solid shading filling two-point worksheet rows for the thick lines at the top and the bottom of the billing statement, and light shading behind the words "THANK YOU." A dark shading—which falls between light and solid—is also available. The figure also demonstrates how Wysiwyg's line commands can be used to generate presentable ruled forms that are suitable for

bills, expense reports, and so on. You might not want to recreate a 1040 form in *Lotus 1-2-3*, Release 3.1, but without an overwhelming amount of effort, you could link statements to a spreadsheet-based accounting system.

TYPOGRAPHIC POWER

Fonts are crucial to any publishing system, even one concerned more with numeric than with text presentations. Wysiwyg supplies four Bitstream families and lets you install sizes from 3- to 72-point. Installation is done only through Release 3.1's Install program; unlike *Quattro Pro*, Wysiwyg won't build fonts on the fly.

The typefaces included are Swiss (Helvetica), Dutch (Times), Courier, and Xsymbol. Xsymbol includes just about every kind of rightward arrow you could want (42 arrows, and all but one of them points to the right) as well as four sets of circled digits. There is not a single bullet included. But the Install program will install any additional Bitstream font you happen to own. Unfortunately, Release

3.1's support of LaserJet cartridges is as pathetic as its predecessor's (only the Z, J, and F cartridges are supported).

A single worksheet may use up to eight combinations of typeface and point size, to which you may also apply boldface and italic attributes. As is the case in *Allways*, a :Format Font Replace command lets you modify the current group at any time. With the use of a handy Library command, you can also create and reuse named sets.

Unlike every other spreadsheet program on the market with publishing pretensions, Wysiwyg even lets you assign font attributes within the contents of a cell. This means that you can start a paragraph of text with a stick-up capital or mix an Xsymbol character in with ordinary text (see the "balance forward" arrow in Figure 5). Unlike most of Wysiwyg's other formatting characteristics, attribute assignments made within an individual cell are stored in the worksheet's .WK3 file, so if you share worksheets with colleagues who don't use Wysiwyg, you'll want to make sparing use of this power. (Wysiwyg keeps almost all of its formatting data in an .FM3 file that uses the same filename stem as the accompanying .WK3 file.)

Borrowing a page from *Microsoft Word*, *Ami Professional*, etc., Wysiwyg also allows you to define up to eight named styles for each worksheet. With this feature, you can encapsulate all the formatting attributes for your main headings or your bottom line into a single command that can be applied and reap-

FACT FILE

Lotus 1-2-3, Release 3.1
 Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 617-577-8500.
List Price: \$595.
Requires: 1MB RAM, DOS 3.0 or later.
In Short: Release 3.1 adds publishing features to 1-2-3 that were desperately needed. Use of a mouse is encouraged, and the package runs under *Microsoft Windows 3.0* in protected mode. Nevertheless, adding PC Publishing's *Impress* to your copy of 1-2-3, Release 2.x, yields most of the same results, so upgrade only if you need the spreadsheet features unique to Release 3.1.

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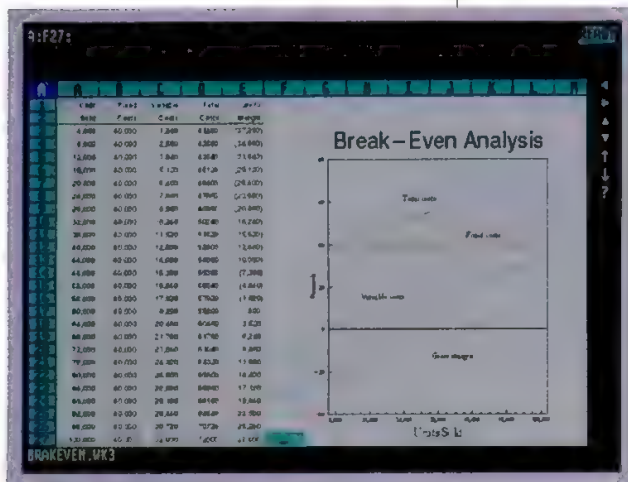
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Figure 6: Graphs displayed on the worksheet can help decipher the meaning of numeric tables.



plied anywhere on the worksheet. Better yet, it means you can easily modify formatting decisions; changes to the attributes assigned to a named style are immediately reflected in every cell where that style has been applied. Most important, named styles can help you achieve stylistic consistency among documents. Each worksheet uses its own set of eight styles, but import and export commands allow you to copy sets from one file to another.

In addition to its font and style commands, *Wysiwyg* offers a set of text-management services that simplify the positioning of labels on the worksheet.

As anyone who's ever done it can attest, centering a heading over a range of columns in *1-2-3* is a clumsy, thankless task. You either have to pad

the left side of your text with blanks (in which case you must adjust the padding if you change your column widths) or write complicated formulas using @CELL and @REPEAT. *Allways* and *Excel* simplify the job by letting centered text overflow a cell's boundaries in both directions. But *Wysiwyg* provides the best solution by letting you designate a block of cells as a text range and center your headings within the range's left and right extremes. If you change column widths or insert new columns into the range, your headings remain centered.

A text range can occupy multiple rows as well as multiple columns, so you can easily create blocks of text to annotate worksheets, as well. Such text can be positioned flush left, flush right, centered, or justified within the range. Best of all, perhaps, the system allows you to make textual changes directly on the worksheet, rather than forcing you to edit lines in the control panel. That way, you can see the effects of your changes immediately, without having to wait until you hit the Enter key.

Wysiwyg's text facilities are no match for those of a word processor. The screen update is slow, and the justification routine thinks that end-of-paragraph lines

should be letter-spaced, but they're a vast improvement over unadorned *1-2-3*.

GRAPHS AND NUMBERS TOGETHER

One of the more welcome benefits provided by *Allways* is the ability to display graphs alongside the numbers from which they were generated. But *Allways* still has a fatal limitation: the graphs must be saved first as .PIC files. If you change the numbers, you have to resave each graph in .PIC format and reinsert it into the worksheet.

Wysiwyg lets you lay out any number of live graphs with your words and numbers. When the numbers change, so do the pictures—unless you turn that automatic response off. (Redrawing takes time. *Wysiwyg* lets you update your graphs on command, should the delays become bothersome.) As Figure 6 shows, a graph positioned beside a table can help you cut right to the center of the matter, revealing patterns that are hard to discern from the table alone.

Figure 6 also shows a small sampling of what can be done with *Wysiwyg*'s graphic annotation features. The labels inside the graph were generated via the :Graph Edit Add Text command, with an assist from :Graph Edit Edit Font. If you have a good eye, a steady hand, and a bit of patience, you can do a great deal more to dress up the output of *1-2-3*'s native charting module. You can draw lines, ellipses, rectangles, and freehand squiggles, import clip art stored in .CGM format, turn text on its ear to be read vertically, and so on.

Wysiwyg also allows you the option of dropping a "blank" graphic on the worksheet. Judging from the package's documentation, this feature was primarily intended to simplify the construction of documents when the charts are not yet available. But with the help of :Graph Edit, you have the ability to turn those blanks into text charts and ultimately make slides from them. *Wysiwyg*, unlike *Quattro Pro*, offers no easy way to generate slide presentations on-screen. (You could possibly do it with the aid of macro programming, but *Quattro Pro* makes graphic sequencing as simple as creating a two-column table.)

When working with graphs you'll be keenly aware that *Wysiwyg* and *1-2-3*, Release 3.1, are two separate entities living together in your memory space. Before you can annotate a graph, you have to use :Graph Add to make a home for it

Peter Norton's
Philosophy
On Data Recovery
Can Be
Summed Up
In Three
Little Words:

Never



Peter Norton

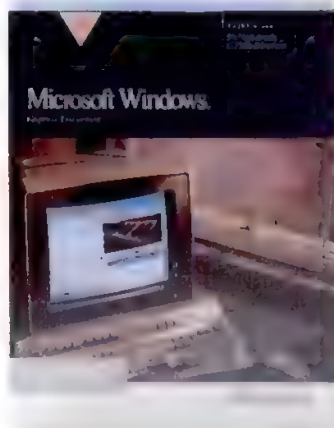
When it comes to your crucial data, Peter Norton just won't take **C>FILE NOT FOUND** for an answer. With programs like the Mace Utilities* and PC Tools*, data recovery is often mission impossible. But with the Norton Utilities* 5.0, data recovery is mission *critical*—and it can recover what no other utility can.

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The Norton Utilities is *the* safe DOS utility program for use with windowing environments like Windows* 3.0 and DesqView.

Because PC Tools and Mace Utilities are blind to multi-tasking, they can irreversibly damage your files. While the Norton Utilities 5.0 offers three full levels of safety checks under Windows 3.0.



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The Norton Utilities is the *only* utility program that provides file recovery on Novell and DOS-compatible networks. So you can use *File Save* along with *UnErase** to recover deleted files,* or *File Fix** to reconstruct Lotus* 1-2-3* and dBASE* files. From any node on the network.

What's more, MIS will appreciate the Norton Utilities' compliance with existing network security restrictions.

System Information provides detailed reports on network information and TSR memory allocation, as well as graphical benchmarks of disk, CPU, network, and general computer performance.

The next best thing to being there is being on the network. And the Norton Utilities 5.0 is the only data recovery tool that is.



DATA RECOVERY FEATURES	NORTON UTILITIES	PC TOOLS	MACE 1990
Number of DOS Error Messages With On-Line Advice	75	0	0
Different Types Of Data Loss Problems Solved			
File System Corruption	31	12	15
Physical Hard Disk Damage	6	0	0
Internal Data File Damage (i.e. dBASE, Lotus)	10	0	6
Disk Reliability Testing (Number Of Patterns)	80	0	0
System Information (Topics Reported)	94	15	16
NETWORK file recovery *File Save must have been installed prior to data loss.	YES*	NO	NO
WINDOWS Safe Operation	YES	NO	NO
Failsafe Design	YES	NO	NO
Effective File Encryption That Does Not Require You To Change The Way You Work	YES	NO	NO

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Norton Utilities 5.0 Adds Features, Improves Interface

"Norton's disk utilities now surpass anything you can find in PC Tools Deluxe or The Mace Utilities, and offer safeguards you can't find anywhere else."
— PC Magazine 10/16/90

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thing you need for optimal system performance.

The new Norton

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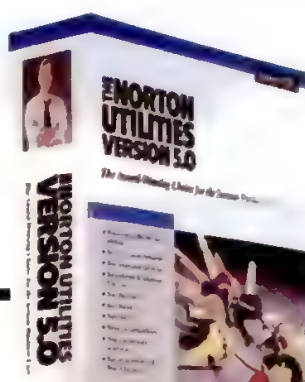
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\$59

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Name as it appears on your card (please print) _____

Acct. No. _____

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Quantity	Disk Size	Unit Cost
One	☐ 5 1/4-inch ☐ 3 1/2-inch	\$59.00
In these states, add sales tax including applicable local tax: CO 3%; GA, IA, MI, NY 4%; MO 4.225%; IN, MD, MA, OH, WI 5%; DC, FL, MN, PA 6%; CA, IL, TX 6.25%; WA 6.5%; NJ 7%; CT 8%.		
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SOFTWARE

LOTUS 1-2-3, RELEASE 3.1

somewhere on your worksheet. Title text added to graphs through 1-2-3's own /Graph Options commands is impervious to Wysiwyg editing, while text and other dress-ups added via the Wysiwyg tools disappear when you press 1-2-3's F10 key. (To see your adornments full-screen, you have to execute Wysiwyg's own View command.)

ONTO THE PAGE

Printing is another area where jurisdictional spats can arise between Wysiwyg and its host. Each has its own Print menu, but if you interrupt a Wysiwyg printout, the error message that arrives comes from 1-2-3. Press F1 for clarification, following the hint at the bottom of the screen, and you're treated to a pageful of irrelevant information from 1-2-3. In spite of less-than-perfect integration, however, you'll be grateful for Wysiwyg's printing services.

For starters, the add-in has the decency to present a settings sheet on request. (Why this feature wasn't in Release 3.0 when Lotus's *Symphony* 1.0 had it back in 1984 is a mystery.) And you can use the :Print Layout Library command sequence to name and save your most commonly

needed page configurations.

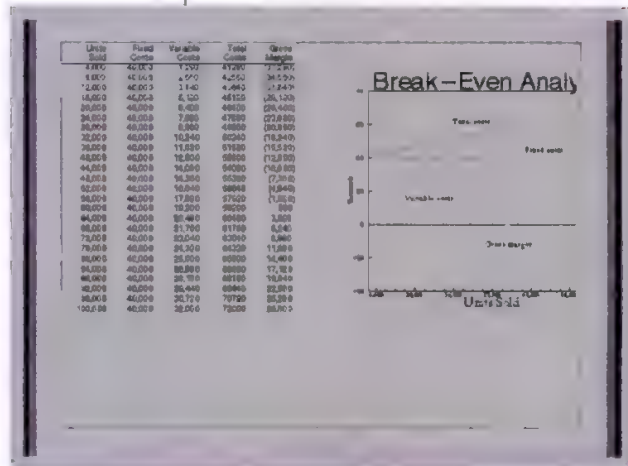
Wysiwyg's preview facility, shown in Figure 7, is rudimentary (it allows no adjustment of margins or print range) but it can help you to evaluate the balance of your page before you send it down to the printer. Even more impressive and useful is the :Print Layout Compression command, which can accept scaling factors from 15 to 1,000 percent of normal size, or automatically scale the current print range to fit on a single page. For worksheet and macro documentation purposes, you have the option of printing the frame—with or without gridlines—along with all of your text, numbers, and graphics.

UNSETTLING ISSUES

Despite Release 3.1's impressive power to beautify and its extension of spreadsheet applicability, some very unsettling issues still re-

Figure 7:

The :Print Preview command can prevent embarrassing mistakes and help you balance white space with text.



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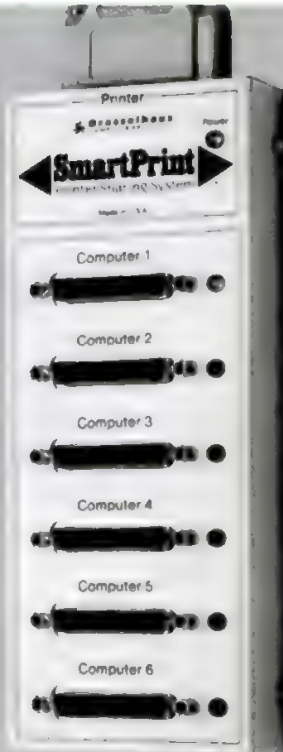
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SOFTWARE

LOTUS 1-2-3, RELEASE 3.1

main about the Release 3.1/Wysiwyg combination. In the first place, Wysiwyg's functionality is added onto, rather than built into, 1-2-3. This imposes quite a considerable ease-of-use penalty on the user. The seams inevitably poke out in many places, and you are constantly obligated to remember which command mode you're operating in. *Quattro Pro*, Lotus's principal competition in the non-Windows

**Wysiwyg's
functionality is added
onto, rather than
built into, 1-2-3.**

arena, offers fewer text-handling features than 1-2-3, Release 3.1, but it's a smoother machine to drive.

Second, although Lotus added virtual-memory capability to Release 3.1, the program is still voracious. Virtual memory lets you build grander models by paging RAM onto disk, but doesn't ease the price of admission. You'll still need 1MB RAM (and an 80286 or later processor) to run Release 3.1.

Third, if you're now using any species of 1-2-3, Release 2.x, you can add Wysiwyg to your current system. For the fullest possible file compatibility with Wysiwyg-formatted .WK3 worksheets, Release 2 users should buy the \$149 *Impress*, Version 2L, package (contact PC Publishing, 1801 Ave. of the Stars, Los Angeles, CA 90067; 213-556-3630). Wysiwyg has a better manual than *Impress*, but the formatting capabilities of the two products are identical.

In short, Wysiwyg is more than just good, and its inclusion in Release 3.1 eliminates one serious reason *not* to move up from Release 2.x. Unless you require the other advanced features of Release 3—multipage worksheets, file linking, the ability to perform relational operations on external data tables, improved graphics, virtual memory, and background printing—Wysiwyg alone doesn't constitute a compelling reason to upgrade. ■

Craig Stinson is a contributing editor of PC Magazine.

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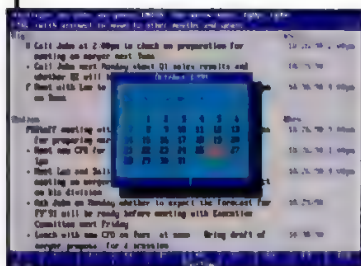
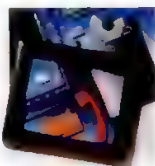
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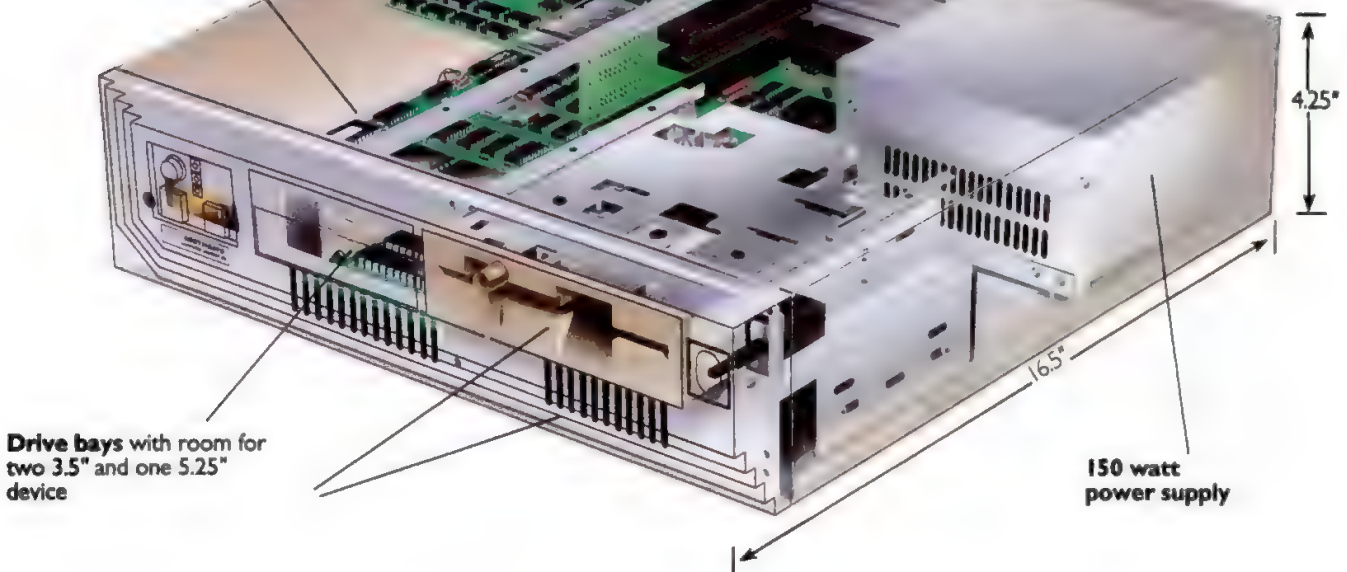
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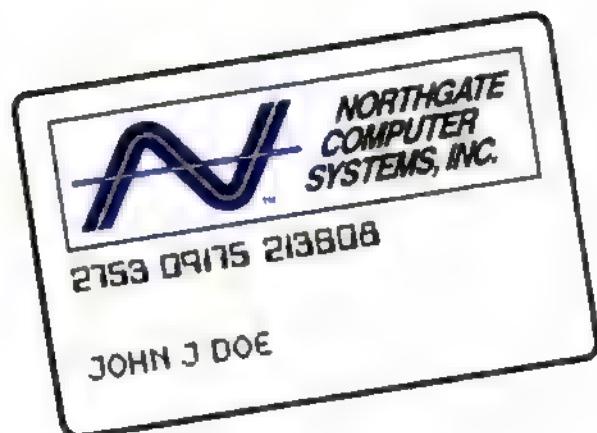
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- ☐ JOINT CREDIT with another person. Complete entire application.
☐ INDIVIDUAL CREDIT complete only individual section.
☐ INDIVIDUAL CREDIT but rely on income of another. Complete entire application.

*If you are a married Wisconsin applicant, you must provide your spouse's information as indicated, even though your spouse may not be signing the contract.

NOTICE TO WISCONSIN APPLICANTS
 You must disclose your marital status:
☐ married
☐ unmarried
☐ legally separated

a. Personal Information

NAME _____ HOME PHONE (____) _____
 SOCIAL SECURITY NUMBER _____ DATE OF BIRTH ____/____/____
 PRESENT ADDRESS _____ CITY _____ ST _____ ZIP _____
 DATE OF RESIDENCE MO. _____ YR. _____ BUY ☐ RENT ☐ OTHER ☐ _____
 PREVIOUS ADDRESS _____
 EMPLOYER _____ DATE OF EMPLOYMENT MO. _____ YR. _____
 MONTHLY GROSS SALARY \$ _____ BUSINESS PHONE (____) _____
 PREVIOUS EMPLOYER _____ DATES OF EMPLOYMENT _____ TO _____
 Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as basis for repaying the obligation.
 ADDITIONAL MONTHLY INCOME \$ _____ SOURCE _____

b. Credit Information

PLEASE TELL US IF YOU HAVE: CHECKING ACCOUNT (Y/N) _____ SAVINGS ACCOUNT (Y/N) _____
 BANK LOAN (Y/N) _____ HOW MANY? _____ VISA (Y/N) _____ HOW MANY? _____
 MASTERCARD (Y/N) _____ HOW MANY? _____ FINANCE COMPANY LOAN (Y/N) _____ HOW MANY? _____
 DEPT. STORE CHARGE CARD (Y/N) _____ HOW MANY? _____ CREDIT UNION ACCOUNT (Y/N) _____ HOW MANY? _____
 OTHER MAJOR CHARGE CARDS (Y/N) _____ HOW MANY? _____

c. Joint Applicant's Personal Information

JOINT APPLICANT'S NAME _____ HOME PHONE (____) _____
 SOCIAL SECURITY NUMBER _____ DATE OF BIRTH ____/____/____
 ADDRESS _____ CITY _____ ST _____ ZIP _____
 DATE OF RESIDENCE MO. _____ YR. _____
 JOINT APPLICANT'S EMPLOYER _____ DATE OF EMPLOYMENT MO. _____ YR. _____
 MONTHLY GROSS SALARY \$ _____ BUSINESS PHONE (____) _____
 NAME AND ADDRESS OF NEAREST RELATIVE NOT LIVING WITH YOU _____
 RELATIONSHIP _____

d. Self-Employment Information

BUSINESS NAME _____ BUSINESS PHONE (____) _____
 TYPE OF BUSINESS ☐ Proprietorship ☐ Partnership ☐ Corporation IN BUSINESS SINCE _____
 YOUR ANNUAL INCOME FROM BUSINESS Gross \$ _____ Net \$ _____
 PERSONAL BANKER'S NAME _____ BANKER'S PHONE (____) _____

e. Customer Authorization

I authorize Northgate Computer Systems or its assignees to investigate credit records and to report my performance hereunder to credit agencies. I hereby certify that the following information is furnished to you for the purpose of obtaining credit and is true and correct of the best of my knowledge and belief. There are costs associated with the use of this credit card. To obtain more information about these costs, call us at 1-800-548-1993 or write to P.O. Box 59080, Minneapolis, MN 55459-0080.

NY—A consumer credit report may be requested in connection with this application or in connection with updates, renewals or extensions of any credit granted as a result of this application. If I subsequently ask for this information, I will be informed whether or not such a report was requested and, if so, the name and address of the agency that furnished the report.

OH—THE OHIO LAWS AGAINST DISCRIMINATION REQUIRE THAT ALL CREDITORS MAKE CREDIT EQUALLY AVAILABLE TO ALL CREDIT-WORTHY CUSTOMERS AND THAT CREDIT REPORTING AGENCIES MAINTAIN SEPARATE CREDIT HISTORIES ON EACH INDIVIDUAL UPON REQUEST. THE OHIO CIVIL RIGHTS COMMISSION ADMINISTERS COMPLIANCE WITH THIS LAW.

APPLICANT'S SIGNATURE _____ DATE _____
 JOINT APPLICANT'S SIGNATURE _____ DATE _____

FOR MARRIED WISCONSIN APPLICANTS:

I acknowledge that the obligation described herein is being incurred in the interest of my marriage or family.

BUYER'S SIGNATURE _____ DATE _____

*This is a credit application. Upon approval, a credit agreement will be sent to you for your signature. This agreement must be signed and returned to activate your account.

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Unfortunately the Information Age is here.
Fortunately there's a printer that can handle it.



NEC Pinwriter P9300

Another day, another load. More reports, more memos, more forms. In triplicate. You don't just need a bigger
in-basket. You need a printer that's fast and reliable. Like the versatile NEC Pinwriter® P9300. With a high-
speed letter quality of over four pages per minute, the P9300 is the fastest printer in its price class. And the
Pinwriter P9300 can process any business media, from single sheets, envelopes, and six-part forms, to
labels and card stock. Extra fonts can easily be added if you find the eight resident type fonts aren't
enough. And just pop in a color ribbon for crisp color output. For high volume, optional single and dual bin
sheet feeders are also available. And if you find you still have more paperwork than you can handle, perhaps
you should consider a shredder. For more information, call 1-800-NEC-INFO.

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DR DOS 5.0

THE BETTER OPERATING SYSTEM?

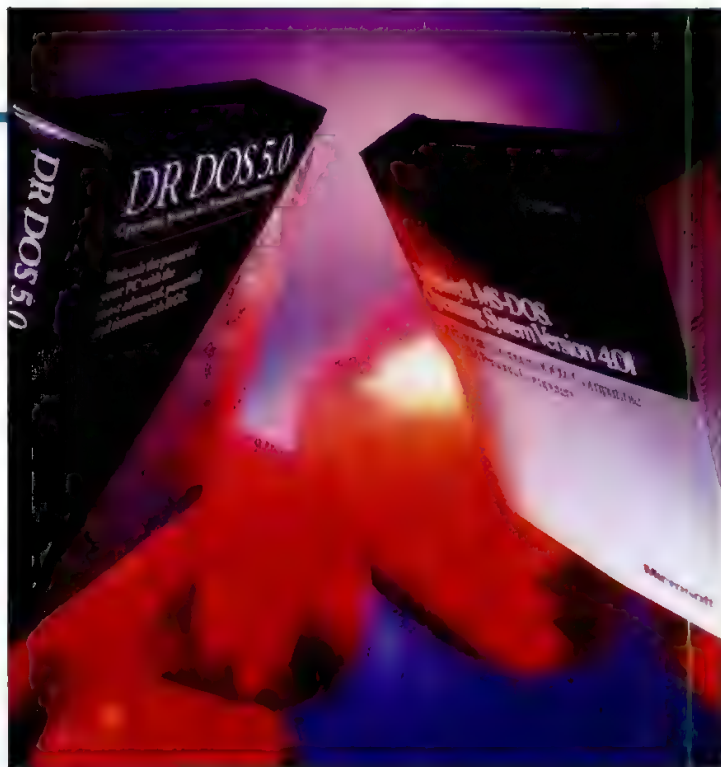
by Winn L. Rosch

Cloning DOS sounds like an exercise in futility. After all DOS isn't just cheap, it's free—it's standard software bundled with most PCs, and in contravention of the copyright laws, exchanged more freely than baseball cards. At that price, the only thing less rewarding than cloning DOS may be buying a DOS clone.

And yet Digital Research has created a series of new operating systems that are completely compatible with DOS. Surprisingly, buying the latest of these, DR DOS, Version 5.0, may not be such a bad idea, even at its \$199 list price.

As Digital Research adamantly points out, DR DOS 5.0 is no mere clone of MS-DOS. In fact, its abilities go far beyond those of the current MS-DOS, Version 4.01. This improvement is the reason the current version number leaps ahead from the previous Version 3.41.

Use it and you'll find that DR DOS 5.0 can remove some of the frustrations involved with using ordinary DOS. The benefits you'll gain by switching to the new DR DOS include more speed (thanks to an included disk cache), an easier menu-driven installation, a design that moves the DOS



With MS-DOS 5.0

still on the horizon,

Digital Research's DOS

alternative offers

leading edge

operating system

technology—and it's

available now.

kernel and software drivers to high memory offering more memory for your DOS applications, and easier control through a graphical user interface that's more like that of an Apple Macintosh than *Microsoft Windows 3.0*. Even the basic DR DOS 5.0 utilities have been enhanced

FACT FILE

DR DOS,
Version 5.0

Digital Research
Inc., 70 Garden Ct.,
Monterey, CA 93942;
(800) 848-1498,
(408) 649-3896.
List Price: \$199.
Requires: 256K
RAM

In Short: An alternative to traditional DOS, DR DOS offers improvements to a number of DOS commands as well as a GEM-style shell, memory management utilities, and battery-saving utilities for portables. MS-DOS 5.0 may offer some of the same functionality when it arrives, but it's likely that DR DOS will push the technology curve forward again.

CIRCLE 407 ON READER SERVICE CARD

to eliminate all the annoyances of MS-DOS that cause people to seek extra help.

The big question is, of course, why should you care? After all, MS-DOS has been old-faithful, a product everyone has come to depend on—in addition to being a curse. While good old MS-DOS doesn't do much, it accomplishes all that it needs to. And because it's been the same for years, you don't have to worry about it.

Digital Research hopes to rustle this tranquil status quo. It sees the key to its gaining market share as upping the ante in operating systems. By increasing innovation and creating a better, more feature-laden DOS, Digital Research hopes to lure you into using its product.

Certainly Microsoft has the resources to match and surpass anything that Digital Research does, but Digital Research sees itself as small, wiry, and fast moving. By putting many new features into its product nine months before Microsoft gets into MS-DOS, Digital Research hopes to establish itself in the operating systems arena.

Even if Digital Research fails in that goal and DR DOS 5.0 wallows as a product, everyone

with a PC will have benefited from it. Already DR DOS 5.0 appears to have inspired Microsoft to add more power to ordinary DOS. It may have pushed up the release date of MS-DOS 5.0. The rumors concerning specific features in the new MS-DOS suddenly started circulating in force a few weeks after the unveiling of DR DOS 5.0 in May, 1990.

If you scrutinize what Digital Research has already done, you'll see that Microsoft has reason to take notice. The operating system is awaiting certification as one of the ten top-selling software packages distributed by Micro-D.

Digital Research also believes that all versions of DR DOS combined now have a 10- to 15-percent share of the worldwide market for PC operating systems. In the last three years, over three million copies (primarily earlier versions) have been sold. Divide that into the 50 million or so PCs that have been equipped with DOS over the past ten years, and you'll see DR DOS now has about a 6-percent penetration among desktop PCs.

COMPATIBILITY CONCERNS

No one is going to try a different DOS, regardless of the features it contains, if it does not run the applications already installed. DR DOS 5.0 meets that challenge. PC Labs' testing shows that for the most part, DR DOS 5.0 is interchangeable with MS-DOS. In fact, DR DOS 5.0 is at least as compatible with MS-DOS 3.3 as MS-

DOS 4.01—probably more so. For example, Microsoft Network requires different drivers for MS-DOS 3.3 and 4.01, but DR DOS will work with either of those drivers.

DR DOS 5.0 will run nearly any program that runs under MS-DOS, including *Microsoft Windows 3.0*. Software drivers, TSR programs, and even deep-delving disk utilities did not demonstrate any new incompatibilities when tested on a range of computers from an IBM PS/2 Model 60 to a 486-based Dell 425e.

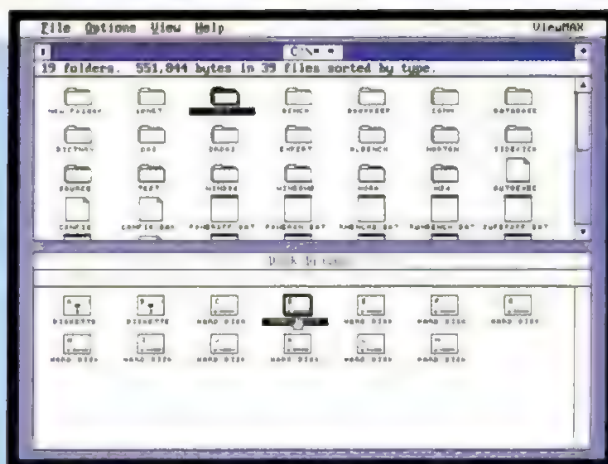
Among the few programs that DR DOS 5.0 would not run during our evaluation were the standard utilities included with MS-DOS. For example, if you try to run Microsoft's CHKDSK under DR DOS 5.0, your system will lock up with its disk drive mindlessly spinning away. Other MS-DOS utilities are less catastrophic in their recalcitrance. For example, when run under DR DOS, MS-DOS FASTOPEN and DEBUG warn "Incorrect DOS version" and return to the DOS prompt without crashing the system.

To avoid these problems in systems switching over from MS-DOS, Digital Research supplies its own versions of all MS-DOS utilities. During the DR DOS 5.0 installation, any existing MS-DOS utilities found on your boot disk are erased.

Another group of programs that DR DOS 5.0 won't work with should be familiar to any of the few folks who have moved up to DOS 4.01. DR DOS 5.0 uses exactly the same disk structure (with one important exception) as MS-DOS 4.0.

Consequently, DR DOS 5.0 allows individual disk volumes to hold up to 512MB, breaking the 32MB limit imposed by DOS, Version 3.31, and earlier. As with MS-DOS 4.01, DR DOS 5.0 supports a new File Allocation Table (FAT) and directory structure to accommodate these larger partitions. Utilities designed for older versions of DOS and that sidestep the operating system to take direct hardware control have difficulty with these changes in disk structure.

For example, disk utilities and uncerasing facilities written before the release of MS-DOS 4.01 may damage the disk FAT when used on DR DOS 5.0 partitions larger than 32MB. Versions of these utilities updated for MS-DOS 4.0 or later will not suffer



ViewMax is DR DOS 5.0's shell based on Digital Research's GEM graphics environment. It works like a Macintosh, combining program and file-management functions in one. Here the entire Lotus 1-2-3 subdirectory is being copied onto the D: drive simply by dragging the subdirectory icon to the drive icon.

compatibility problems with DR DOS 5.0.

Beyond DOS utilities, however, you won't face compatibility problems with DR DOS 5.0. Even the IBM BASIC interpreter that's included on PC-DOS distribution floppy disks will execute through

to move from one DOS to the other. Command options under DR DOS are a superset of those used by MS-DOS, so any command switch you normally use

with MS-DOS commands will work much the same under DR DOS 5.0. The instruction manuals that step you through program installation will be valid for both DOSs.

On the other hand, the code underlying DR DOS differs substantially from MS-DOS. Disassembling the code reveals wide ranging differences in instruction sequences, and watching various software interrupts in operation shows that the two operating systems take entirely different approaches to the job at hand.

Out of the two, DR DOS 5.0 is in many ways the better design. While MS-DOS freely mixes code and data in its kernel, DR DOS keeps the two structures separate. One important consequence of this difference is that DR DOS is able to execute from ROM. While MS-DOS in its present incarnation can be stored in ROM (as it is in many laptop computers, such as the Toshiba T1000SE), MS-DOS cannot run from ROM. The MS-DOS kernel must first be copied into RAM to execute.

The difference does not appear significant until you try to run a large application over DOS. MS-DOS by necessity steals a portion of the 640K allocatable to programs, leaving from 585K (under MS-DOS 3.3) to 567K (under MS-DOS 4.01) free. The ROM holding the kernel of DR DOS 5.0 is addressed as part of

the BIOS area and does not impinge on the 640K of application memory at all. This effectively frees an additional 41K RAM, leaving about 630K for applications. Getting this extra room for applications requires DR DOS to be in ROM. At least one manufacturer (Cardinal Technologies) is developing an expansion board that will put a ROM containing DR DOS 5.0 into your system.

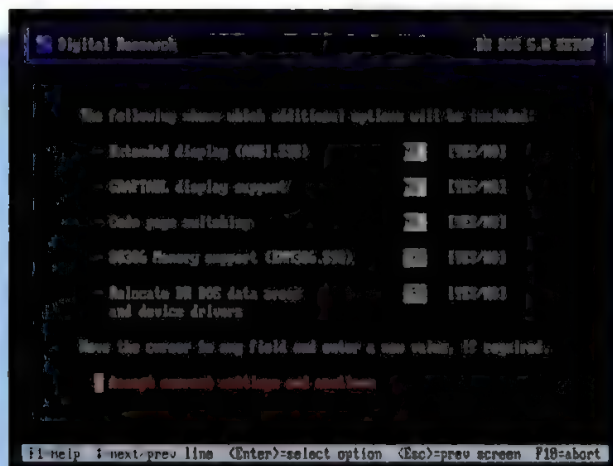
Putting DOS in ROM also means that computers can boot without accessing a disk. And with no need to spin a disk, less power would be used in battery-powered systems.

ROM ability is valuable for personal computers, but it also allows engineers to design computers, or simply intelligent devices, without disk drives and support circuitry, while retaining the familiar DOS environment. The combination of an AT-on-a-chip (announced by Advanced Micro Devices in October) and DOS executing in ROM has the potential to put AT power in many mundane household appliances.

Many of the companies licensing DR DOS have such applications in mind. For instance, Symbol Technology of Irvine, California, is incorporating it into its line of hand-held data-entry terminals. A number of companies including Republic Technology and Emerald Computers are putting DR DOS into the ROMs of diskless workstations.

PERFORMANCE PREMIUM

Despite the external resemblance of DR DOS to MS-DOS, Digital Research re-



DR DOS, Version 5.0, includes a menu-driven installation utility that builds both CONFIG.SYS and AUTOEXEC.BAT files automatically. The setup program lists the default options of DR DOS 5.0 on several screens, each one changeable via the cursor keys. All the necessary setup file entries are then automatically made.

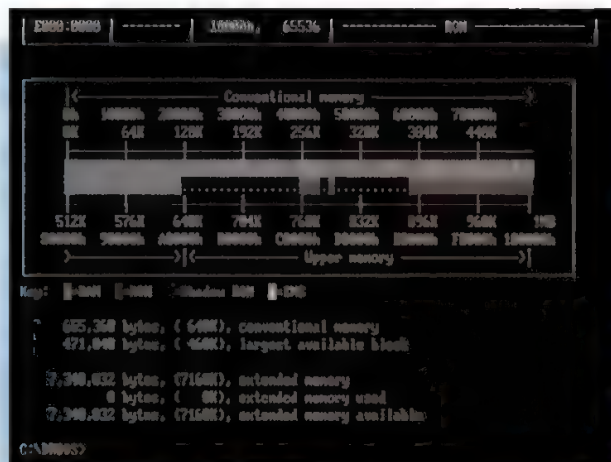
DR DOS 5.0 on PCs that have an IBM BIOS. Microsoft's GWBASIC will run without difficulty under DR DOS 5.0. (That's important because BASIC is not included with DR DOS 5.0.) Compatibility is not a issue with DR DOS 5.0.

DOS DOPPELGÄNGER

Digital Research is quick to point out that while DR DOS is compatible with MS-DOS, it is not a copy of it. Any direct copying would be prohibited by copyright law. Much like the ROM BIOSs that are created by reverse engineering, DR DOS was developed by working backward from the MS-DOS specification and the demands of applications.

While it's unlikely that the C> prompt could be copyrighted even under today's liberal look-and-feel interpretation of the law, the messages given by various DOS commands might be copyrightable. Here DR DOS goes in its own direction. Although some of the terse messages delivered by DR DOS 5.0 are the same as MS-DOS (Abort, Retry, Fail) others are quite different.

The only real similarities between MS-DOS and DR DOS 5.0 are where it counts. Most of the command names are the same so you don't have to learn a new language



Although the DR DOS 5.0 commands generally respond with messages similar to those of MS-DOS, some utilities have been enhanced. MEM, which is shown here, presents a text-mode graphic display of memory usage.

sents the use of the term "clone" to describe its product. The company prefers to call its creation a "high-performance alternative to DOS."

By performance, Digital Research doesn't mean that your applications will necessarily run any faster under DR DOS. We checked. You won't see an improvement in execution times during normal program usage. If anything, DR DOS is in fact a tiny fraction slower than MS-DOS 3.3 on some disk procedures, but the difference probably isn't large enough that you'd notice. After all, when speed really counts applications usually sidestep the operating system (for example, writing

directly to display memory).

A better term for DR DOS 5.0 is "premium" because it offers advanced features not present in DOS 4.01. These range from enhancements and brand-new utilities to facilities rivaling commercial applications.

Nearly every utility that DR DOS 5.0 shares with MS-DOS has been improved in some way. In most cases, DR DOS 5.0 adds to the options available under MS-DOS 4.0. Most DR DOS commands include an /H option that provides help by listing the proper command syntax and

available options on-screen. Often, extensive new powers are added to utilities—CHKDSK, which also includes disk repair functions, and MEM, which digs deeper into memory usage and gives a graphic display.

Beyond the basic MS-DOS utilities, DR DOS 5.0 adds several dedicated convenience enhancements that are not part of MS-DOS 4.01. Among these are queried erase facilities, an extended delete utility that handles nested subdirectories with a single command, an extended directory display, and a program to change the time and date stamps of files.

In addition to these simple utilities, DR

INTERNAL AFFAIRS: DR DOS vs. MS-DOS

by Winn L. Rosch

The designers of DR DOS, Version 5.0, went on ppeeve patrol to scout out all the missing options that users wanted to see in MS-DOS, Version 4.0. These features include some elaborate disk-fixing utilities, as well as the basic ability to change "all" the attributes of a file. Some commands in the two DOS versions differ only in the operations of options, while others work identically. Listed in the following paragraphs are some of the differences you may encounter.

ATTRIB has been given the additional power under DR DOS 5.0 to change the hidden and system attributes of files using its /H and /S switches.

BACKUP works similarly to the MS-DOS version. In fact, floppy disks made with DR DOS's backup are readable by the MS-DOS RESTORE program included in Version 3.0 and later. DR DOS can also conveniently restore MS-DOS backups.

CHKDSK has been expanded under DR DOS 5.0 from a simple error detection tool to a preventive maintenance and limited disk-repair facility. For example, instead of finding lost clusters and reporting disk errors as the MS-DOS CHKDSK command does, DR DOS, Version 5.0, finds and marks bad disk clusters, and even rebuilds cluster links to repair a bad File Allocation Table. When actually checking the disk, the program verifies that all is well, maps faulty clusters (the /M switch), and even indicates which clusters hold directories (the /P option). When things go really

sour, it locates lost directories (the /D switch) and even recovers the root directory to help find any subdirectories that may be lost in it (/R).

DR DOS's COMMAND works identically to MS-DOS's COMMAND.COM and uses the same options, except /MSG. It can be used temporarily or installed in memory permanently.

COMP under DR DOS 5.0 is not quite as frustrating as the MS-DOS version. It shows the relative mismatches between files in hexadecimal or straight ASCII characters. In addition, it allows you to specify how many differences to show you before it gives up. MS-DOS thinks ten is the optimal number for all circumstances.

COPY under DR DOS 5.0 includes a few options that old-timers will remember from CP/M days. For example, high-bit characters (the pesky italic "I"s in *WordStar* files, for instance) can be stripped off during the copy process using the /Z switch. System and hidden files can be included in wildcard copying (/S option) and you can even have DR DOS query you before each file is copied using the /C (for confirmation) switch.

DIR has been enhanced to eliminate the need for typing the same command switches repeatedly. It can remember the options you set, so typing DIR will give you wide displays or pause between screens full of files.

FASTOPEN under DR DOS 5.0 is a vestigial command. It doesn't do anything because it is triggered in

CONFIG.SYS. A dummy program is included because the automatic installation routines of some applications demand that you have a FASTOPEN command.

FORMAT under DR DOS 5.0 works only for floppy disks and has the same complex, annoying options as those found in MS-DOS. Hard disk formatting is handled by FDISK, making the ultimate mistake—reformatting your hard disk—an even more remote possibility.

GRAPHICS is more limited under DR DOS 5.0—giving you the choice of using color or not using color. Its graphics output is fixed for printing graphics screens to standard IBM-compatible printers.

MEM, introduced in MS-DOS, Version 4.0, is enhanced in DR DOS 5.0 with a variety of choices instead of the simple /PROGRAM and /DEBUG options found under MS-DOS. For example, /M will show you a graphic display of all RAM (including EMS) and ROM. You can see how that memory is put to work using the /B switch to show you where BIOS memory and device drivers are assigned (/D for device drivers alone).

RECOVER under DR DOS 5.0 is extended to individual files. Using RECOVER you can save all the data from the good sectors remaining in a file when a cluster goes bad.

REPLACE under DR DOS 5.0 includes a clever preview mode that uses its /N switch to run through the same

DOS 5.0 includes programs that mimic many of the more-popular aftermarket DOS enhancements, such as extended and expanded memory managers, a cursor control program, a file transfer utility, a disk cache, and password protection. In general, these enhancements are effective but less versatile than their aftermarket equivalents. For example, CACHE, a DR DOS 5.0 program that will turn up to 4,096K of extended or expanded memory into a disk cache, pales in comparison to Multisoft's *Super PC-Kwik*. CACHE only caches disk reads, while *Super PC-Kwik* handles both reads and writes. And while CACHE offers some improvement in disk

performance, *Super PC-Kwik* is dramatically faster.

FILELINK adds to DR DOS the PC-to-PC file exchange capabilities of packages such as *LapLink* and *Brooklyn Bridge*. It allows two PCs to exchange files through serial ports at rates up to 115,200 bits per second. FILELINK can clone itself through a serial cable. Run it on its home DR DOS system, and it will send data through the DR DOS or MS-DOS CTTY terminal emulation utility to build a copy of itself on the remote system.

Although hardly as feature-packed or

operation the command will accomplish without changing a file. You can see the damage that you'll do before actually creating a disaster.

SHARE under DR DOS 5.0 does not support MS-DOS's /F switch to specifically allocate a number of bytes for data storage.

SYS has been improved under DR DOS 5.0 so you don't have to worry about leaving the first cluster free on a disk that you want to make bootable. The DR DOS system files can be located anywhere on the disk, so any disk with enough free space can be set to boot your system.

TREE under DR DOS 5.0 not only displays files and their relationships to subdirectories, it also shows the file size and the number of files in each directory.

TYPE under DR DOS 5.0 recognizes when it has filled a screen without relying on the /MORE filter. Just type the /P switch.

XCOPY is expanded under DR DOS 5.0 to copy hidden or system files with its /H switch and can overwrite read-only files when its /R switch is used. It will prompt you before copying each file when you give the /C or /P switches, and it even waits for you to insert floppy disks when you use the /W switch.

NEW UTILITIES

DR DOS 5.0 also includes several utilities that are not part of MS-DOS 4.01, and can make using your PC a little more convenient. DELQ and ERASEQ

are queried erase utilities. Instead of erasing your entire directory, they query you to choose Y or N before erasing each file when you give a wildcard file specification.

XDEL enhances the erase function, allowing you the ability to delete files from multiple subdirectories by giving its /S option. Although it normally queries you before completely destroying the contents of a directory, an /N option will cause it to eliminate files without asking about each one. With the /R switch, it will also remove read-only files, and /D will cause it to remove the empty subdirectories it would otherwise leave behind.

XDIR enhances directory displays, sorting them alphabetically (the default) by time stamp (/T), file size (/Z), or in reverse order (/R), including subdirectories (/S) and pausing between full-screen displays (/P). Files can be included or excluded by attribute. By default you get a full listing of file parameters, but you can cut it down to the essentials with the /B option or in a wide display with the /W option—much like MS-DOS.

TOUCH is a new command that changes the time and date stamps of files similar to the way ATTRIB changes their attributes. Options include touching files in subdirectories, changing the time stamps on read-only files as well as unprotected files, and selecting among different formats for the time code—United States, European, or Japanese. ■

versatile as *LapLink*, FILELINK can be a quick and economical way of moving files from one system to another. It will even transfer files in a command-driven mode that's hardly different from copying them. The utility requires a crossover cable to link to a remote PC, and the DR DOS manual includes a pin-out guide so that the adventuresome can make their own cable.

MemoryMax gives DR DOS 5.0 the ability to relocate its kernel, software drivers, and TSR utilities out of the 640K DOS memory range in computers based on 80386 and 80486 processors, as well as 286-based machines using the Chips and Technologies NEAT chip set. Separate utilities are provided in DR DOS 5.0 for controlling high memory (MEMMAX), relocating drivers in CONFIG.SYS (HIDEVICE), relocating TSR programs (HILOAD), and moving the DOS kernel to the first 64K of extended memory (HIDOS). DR DOS 5.0 also includes an EMS driver that changes extended memory into expanded memory.

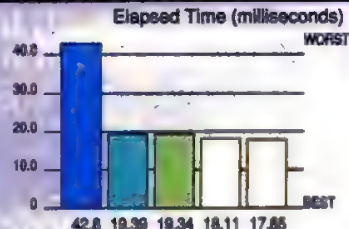
Beyond the basic MS-DOS utilities, DR DOS 5.0 adds dedicated enhancements that are not part of MS-DOS 4.01.

PASSWORD provides a degree of security (although not a great one) to DR DOS 5.0 files. This command allows you to completely hide individual files or directories from the view of unauthorized people, and to restrict those who may read, erase, or change files. All the DR DOS 5.0 commands understand this password system. Using a protected file is simply a matter of appending the assigned password after a semicolon at the end of a filename in the command. With the global access switch, you can access all the files on an entire disk that use the same password without using the password on each one. That way vintage programs that don't understand the password system will still work properly with protected files.

For those in fear of the DOS prompt, DR DOS 5.0 offers *ViewMax*, a graphic-oriented DOS shell. *ViewMax* looks un-

BENCHMARK TESTS: DR DOS

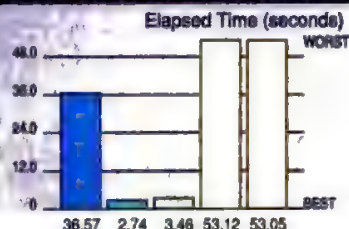
DOS Disk Access



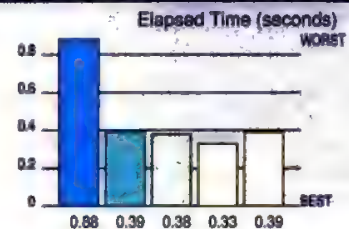
The performance differences between MS-DOS and DR DOS are not noticeable in most cases. Interestingly, the integrated disk cache in DR DOS actually inhibits performance more than it helps on some tests.

The DOS Disk Access test measures the time it takes to do a random sector read using DOS. DOS buffers are set at three and the interleave factor is left at the drive's default setting. This test adds DOS's overhead to the BIOS and hardware times, and performs the sector read 1,000 times within the DOS disk partition. The average access time is expressed in milliseconds.

DOS File Access (Small Records)



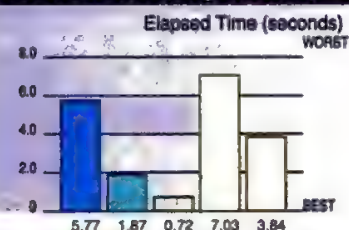
Video BIOS Routine Without Scrolling



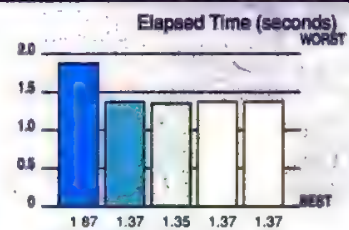
The DOS File Access (Small Records) benchmark test times throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous for loading large files.

DOS File Access (Large Records)



Video BIOS Routine with Scrolling



The Video BIOS Routine Without Scrolling benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

The Video BIOS Routine with Scrolling benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

DR DOS: COMPOSITE VIEW

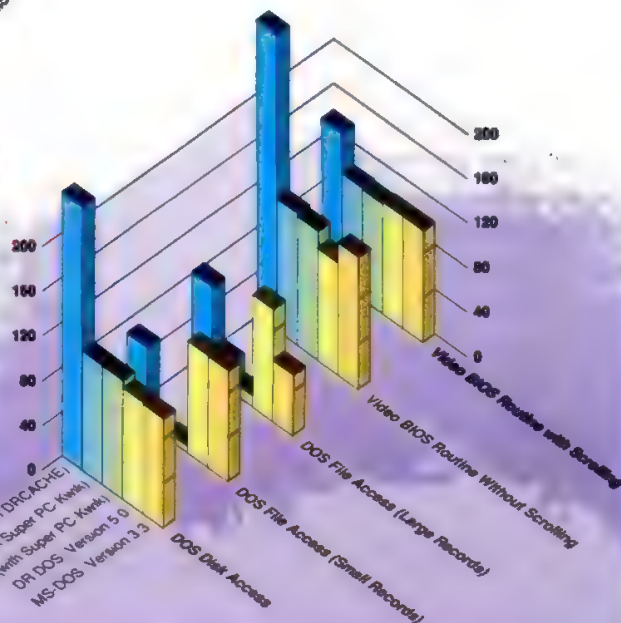
For our tests, we used a 25-MHz 486-based Dell 425e with an ESDI hard disk. The results show that DR DOS, Version 5.0, offers performance comparable to MS-DOS, Version 3.3, on most disk-related tasks. With small records, the two operating systems stand on nearly equal footing, but as the record size increases, DR DOS 5.0 lags slightly behind.

Disk caching, of course, improves the performance of any hard disk system. DRCACHE, the cache program included with DR DOS 5.0, works only with disk reads, so it doesn't yield a dramatic improvement in overall file access times like Multisoft's Super PC-Kwik does.

DRCACHE apparently imposes other speed obstacles that slow down DOS Disk Access times on the benchmark tests. Note that while Super PC-Kwik also hinders access speed, the effect of DRCACHE is much more dramatic.

DRCACHE also affects the BIOS-mediated display times in a negative way. Otherwise, DR DOS and MS-DOS deliver identical screen response times, with or without Super PC-Kwik.

The performance differences between the two operating systems are inconsequential in normal use, but both systems can benefit from good disk caching software. However, DRCACHE may not be good enough to keep most users happy.





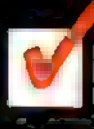
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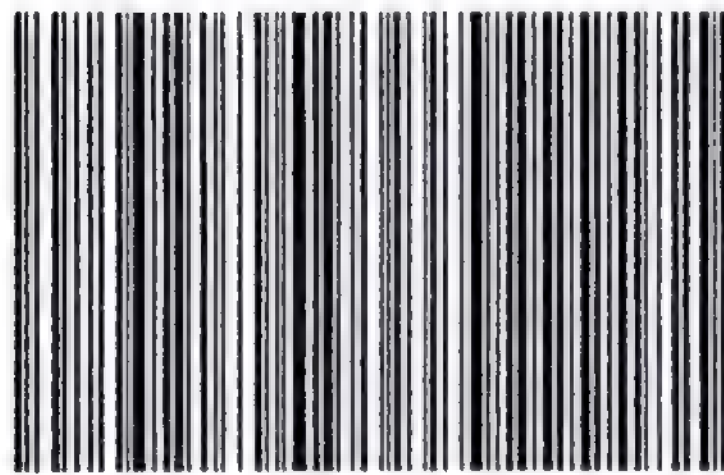
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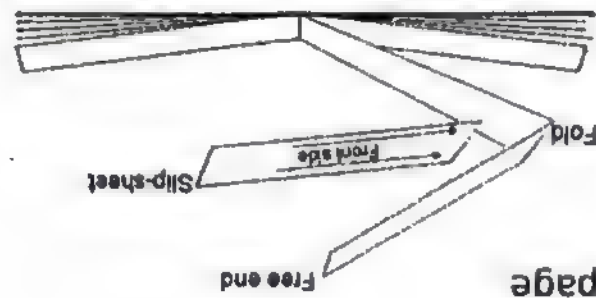
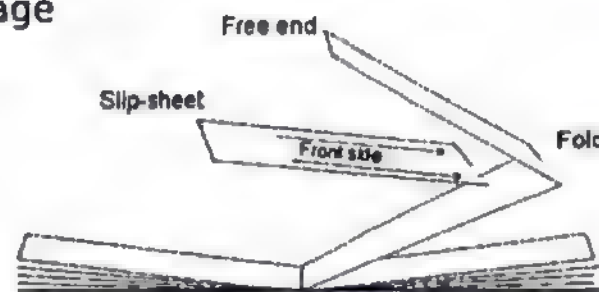


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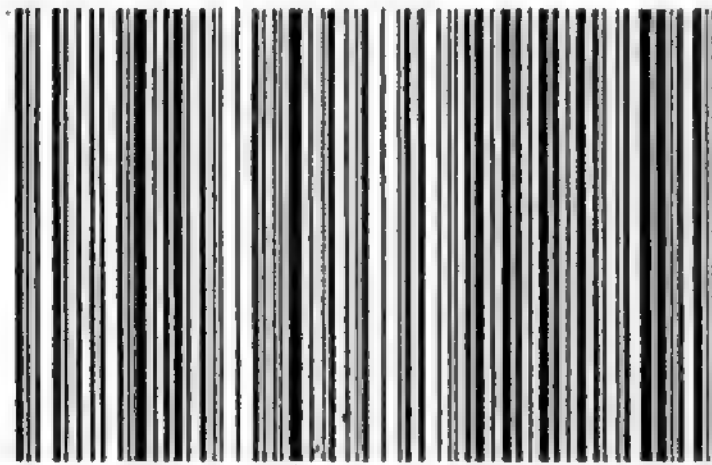
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Reason #3

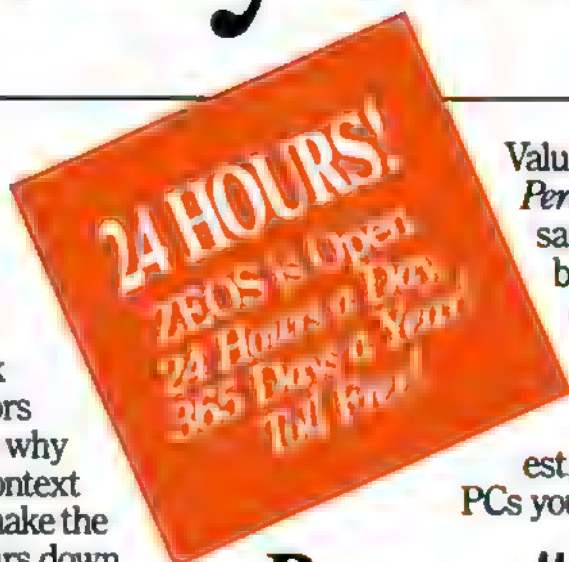
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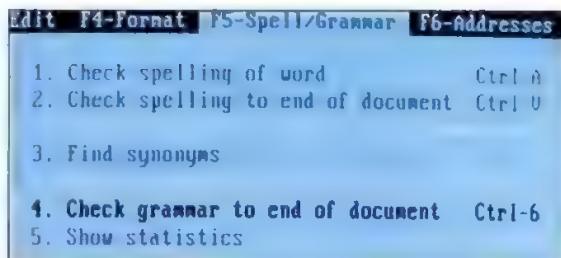
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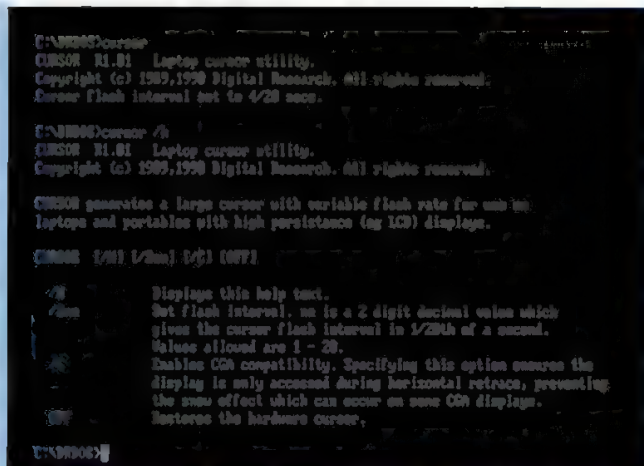
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Nearly all DR DOS 5.0 commands respond with a help screen when you use their /H switch. Here, the CURSOR command shows the function of its various switches. Note the enlarged cursor produced by the utility.

cannily like GEM, and Digital Research readily admits to a cross-pollination between the products—with *ViewMax* being the superior implementation. The interface works with or without a mouse (GEM requires a mouse) but requires a graphic display system. The mouseless keystrokes match IBM's Common User Access (CUA) standard for pull-down menus.

In some ways, *ViewMax* is more like an Apple Macintosh than like *Windows*. For example, while *Windows* isolates its File Manager from its Program Manager, *ViewMax* combines the two into a single entity. Clicking on the icon of a program will run it, and you can copy a file by clicking on its icon and dragging it to another disk or directory.

Like most DOS shells, tuning *ViewMax* takes more skill than using it. It will probably be most effectively used in the corporate environment where a PC manager can set it up for less-skilled operators, customizing it for a particular business environment.

MORE COMPATIBLE WITH YOU

DR DOS 5.0 makes working with an operating system more convenient in other ways, too. For example, unlike MS-DOS, DR DOS 5.0 isn't demanding about where on a boot disk its system files are located. While MS-DOS requires the initial sectors of a disk to be reserved for system files, DR DOS 5.0 can find these critical files wherever they are on disk. You can make any disk bootable.

Making a disk bootable is more convenient with DR DOS 5.0 because its SYS utility knows that copying hidden system files is not sufficient to prepare a boot disk. It also copies COMMAN.D.COM along with the system files in one smooth operation.

The boot-up process is more convenient, particularly when you rely on your system for different functions at differ-

ent times. DR DOS 5.0 allows for the conditional loading of drivers through its CONFIG.SYS file based on your interactive choice. A simple question mark at the beginning of a CONFIG.SYS entry will cause the operating system to query you

about loading a particular driver. You can also add a prompt to the query to guide yourself through the selection process. Although it's not extraordinary, it's characteristic of the detailed work that has been lavished on DR DOS 5.0 to make it a more-perfect operating system.

DR DOS also includes its own screen-oriented editor called, appropriately, EDITOR. The interactive, full-screen view alone makes it vastly superior to EDLIN that's included with MS-DOS. The DR DOS editor understands cursor keys and *WordStar* diamond commands, including block moves. Unlike *WordStar*, it does not support search or replace operations and saves files only as standard ASCII characters.

DR DOS 5.0 maintains a command-line history. You can specify the size of a buffer used to store the commands you type at the DOS command line. To recall a previous command, you only need to press a function key. You can edit old commands using the same keystroke as MS-DOS command-line editing.

SELF STARTER

Properly installing an advanced operating system and tuning it for best performance

THE DOS FAMILY TREE

by Winn L. Rosch

According to an industry myth, Microsoft's appointment as the main supplier of operating systems for the PC was more a matter of fate than technical quality. A product from Digital Research was IBM's original choice.

In 1981, the most-common operating system for small computers was CP/M, the Control Program for Microcomputers, penned by the same Digital Research that now offers DR DOS, Version 5.0. At that time, CP/M was hailed as the first standard in microcomputing, the one that opened up the business market to thousands of computers and users.

According to the myth, when IBM was under the gun to prepare the PC for its unveiling, they couldn't find the head of Digital Research, Gary Kildall, to cut the deal. Kildall was rumored to be out flying his airplane, racing his sports cars, or negotiating in the Orient to license CP/M to another manufac-

turer. Unable to reach Kildall, IBM paid a visit to a tiny, unknown software company in Washington state: Microsoft. Supersalesman, entrepreneur, and Microsoft president Bill Gates talked his way into supplying the operating system for the PC. (Although IBM also sold CP/M-86 for the first few years, it was a dismal also-ran.)

Microsoft bought the actual operating system that was to become MS-DOS from Seattle Computing. The operating system was basically a reworking of the CP/M concept for the 8088 microprocessor on which the first PCs were based. (Version 2.0 of MS-DOS was rewritten from scratch.)

Kildall keeps the tale shrouded in mystery, a good way of placating one's soul for missing the knock of a multibillion-dollar opportunity. But the real moral of the story is that DR DOS 5.0 is no mere copy. You could call it a reverse-engineered update to Digital Research's own product. ■

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- 8040 □ FaceLift for WordPerfect 5.0/5.1 59.

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- 6245 □ Pop Drop Plus 1.0 59.

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- 7356 □ Turbo Pascal Professional 2nd Ed. 179.

- 6242 □ Quattro Pro 2.0 339.

- 1514 □ Paradox 3.5 529.

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- 7546 DOS Membership Kit 23.

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- 7795 □ Disklock 1.0 109.

- 3950 □ Fastback Plus 2.1 119.

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- 5810 □ FormWorx with Fill & File 2.5 85.

- 7311 □ Form Publisher for Windows 1.2 139.

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- 6188 □ FoxPro 1.02 459.

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- 7071 □ Language Master 3.0 49.

- 7416 □ Language Master 3.0 for Windows 59.

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 5134 ☐ Magellan 2.0 109.
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 2798 ☐ Managing Your Money 7.0 135.
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 7649 ☐ Virex 1.1 79.
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Revolution Software ... NCP
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- 6791 ☐ **WordStar Prof. 6.0** ... 279.

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- 8126 ☐ **Running with DOS 4th Edition** ... 20.
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- 5231 ☐ **Phonics Plus** ... 22.
- 3433 ☐ **Algebra Plus Vol 1 (ages 13+)** ... 27.

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- 7676 ☐ **Nemesis Go Master Deluxe** ... 88.

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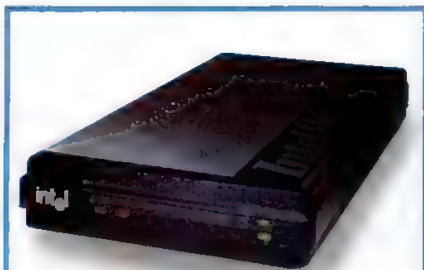
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- 1917 LQ-1050 (136 col., 264 cps, 24 pin) call
- 5184 LX-810 (80 col., 180 cps, 9 pin) . . . 185.
- 7775 Equity LT-286e Laptop (1 yr wrty) . . 1995.
- 7774 Equity LT-386SX Laptop (1 yr wrty) 3069.

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- 8049 JTFax 9600B 499.
- 7391 Ultra 9600 Modem 799.

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- 4696 2400B Internal Modem 159.
- 2352 2400B Internal Modem 2 (for PS/2) 249.
- 5119 2400 Baud External Modem 179.
- 6420 2400EX MNP Modem 229.
- 7880 9600EX Modem 549.
- 2346 Inboard 386/PC w/1 Meg 495.
- 5336 Above Board Plus 8 2 Meg 599.
- 5342 Above Board Plus 8 I/O 2 Meg . . . 629.
- 7782 SatisFAXtion (fax board) 399.

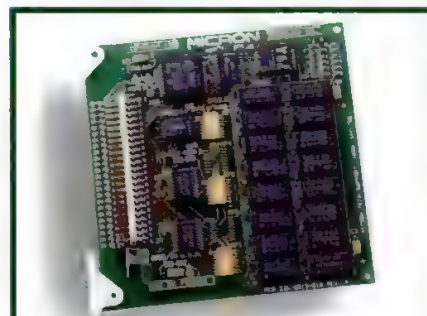
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- 5813 Game Card/Thunderstick Bundle . . 55.
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- 7768 C9 Mouse with Windows 149.
- 6029 Trackman (Trackball) serial .85. bus 89.
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- 7012 Beyond Memory Board for PS/2 Model 70 (2 Meg) 149.
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- 2897 Mouse with Paintbrush 105.
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- 5085 Multisync 3D Monitor 689.

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- 7053 InnerSource 2210 399.

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- 6779 25 Cartridges in One! (for LJ II, IIP, III) . . . 275.

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- 7758 3 Meg 269. 7759 4 Meg . . . 329.
- 7158 Pacific Page 4.0 (for LaserJet IIP/III) 379.
- 6834 Pacific Page with free 2 Meg

Memory Board (for LaserJet II) 379.

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- 3102 2400 Baud External Modem 179.
- 5286 2400 Baud Int. MNP Modem (Lex. 5) 169.
- 5285 2400 Baud Ext. MNP Modem (Lex. 5) 209.
- 4542 2400 Baud Internal Modem for PS/2 . 229.
- 8132 PM2400 Pocket Modem 109.
- 7934 PM9600SA Modem 489.

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5113 44 Meg Cartridge Tripak (5 1/4")	249.
2500 PC2B Controller	229.
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8304 Hardcard II XL 50 Meg (9 ms)	399.
8287 Hardcard II XL 105 Meg (9 ms)	689.
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2286 30 Meg Int. Hard Drive ST238R (w/controller and cables, 65 ms)	269.
4554 40 Meg Int. HD ST251-1 (28 ms)	329.

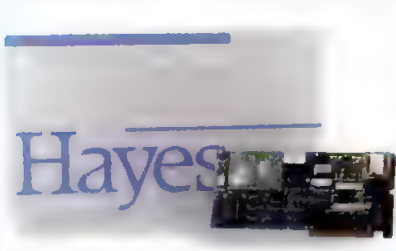
TEAC ... 1 year

4670 1.44 Meg Drive for PC/XT (3 1/2")	\$89.
4326 1.44 Meg Drive for AT	109.

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2792 3 1/2" DS/DD 720k Diskettes (Qty. 10)	14.
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3297 3 1/2" DS/DD 720k Diskettes (Qty. 10)	13.
3298 3 1/2" DS/HD 1.44Mb Diskettes (Qty. 10)	22.
8185 QD 2040 Tape Cartridge	19.

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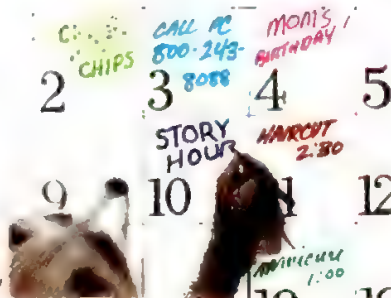
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can be extremely difficult. Tuning MS-DOS means trial-and-error testing of various CONFIG.SYS and AUTOEXEC.BAT files, adjusting parameters as delicately as trying to tune Radio Moscow on a crystal set.

The automatic setup procedure in DR DOS 5.0 does a good job of eliminating most of the installation hassle. Boot from the DR DOS 5.0 setup disk, and the procedure swings into action. It even allows you to select the features you want, explicitly (how much EMS, how many buffers) or by tuning the operating system for the best possible performance, maximum available memory, or a compromise between the two.

Once you've made your choices, DR DOS 5.0 automatically makes the necessary entries and alterations in your boot-up files. If it doesn't understand some of the commands in your existing file, it will wall them off and let you do the editing. Setup then copies all the DR DOS files to your hard disk and erases any MS-DOS it finds. Setup also copies itself to your hard disk as part of the installation, so you can easily use the same procedure to reconfigure DR DOS whenever your setup changes.

Setup is not effortless, however. You can easily ask for combinations of fea-

DR DOS 5.0 automatically makes the necessary entries and alterations in your bootup files. If it doesn't understand some of the commands in your existing file, it will wall them off.

MS-DOS 5.0: Trouble on Digital Research's Horizon?

by Winn L. Rosch

Call it a response to DR DOS, Version 5.0; call it the Tenth Anniversary of DOS; or just call it MS-DOS 5.0. The next incarnation of Microsoft's disk operating system will probably match nearly every feature found in DR DOS 5.0 and raise the standard even further.

Like DR DOS 5.0, MS-DOS 5.0 will have an easy installation program and a menu-driven shell. As DR DOS relies on a GEM-influenced design for its shell, Microsoft will pattern its interface after *Microsoft Windows 3.0*.

The MS-DOS, Version 5.0, shell will offer some distinct advantages over DR DOS. Microsoft will provide a text-mode shell; the DR DOS 5.0 shell works only in graphics mode. In addition, the MS-DOS 5.0 shell will incorporate a built-in task switcher, which allows you to switch between several programs loaded in memory at the same time just by pressing a key. DR DOS 5.0 does not have task-switching abilities.

MS-DOS 5.0 will not offer true multitasking—you'll need *Windows 3.0* for that. Digital Research does offer its own multitasking system, *Concurrent DOS*, although *Windows 3.0* will operate under DR DOS 5.0 as well.

MS-DOS 5.0 will match many of the other features of DR DOS 5.0. For example, help for each command will be available using the */?* switch just as DR DOS 5.0 gives you help with its */H* switch. Digital Research delivers a full-

screen editor, and so will Microsoft. And MS-DOS 5.0 will also maintain a command-line history. Beyond what DR DOS 5.0 offers, MS-DOS 5.0 will give you the ability to unerase files and unformat disks.

MS-DOS 5.0 will also include many of the same advanced features of DR DOS 5.0 that otherwise must be supplied by aftermarket software. Files will be easily transferred between PCs using its DOS-connect feature. MS-DOS 5.0 will also incorporate a built-in power-management system to conserve battery power in laptop computers. Also to be included with MS-DOS 5.0 is a new BASIC interpreter, derived from Microsoft's QuickBASIC.

The kernel of MS-DOS 5.0 has been completely rewritten. Like that of DR DOS 5.0, it will allow execution from ROM. In addition, MS-DOS 5.0 will incorporate a memory manager that can relocate the MS-DOS kernel, device drivers, and TSR programs to high memory. Typically, the impact of MS-DOS 5.0 on the base 640K of DOS memory will be only 15K in 386- or 486-based computers.

Will MS-DOS 5.0 eventually beat DR DOS 5.0 in power and features? Probably. But its release will come almost a full year after the release of DR DOS, and Digital Research promises to leap ahead of MS-DOS 5.0 with future DOS offerings. Stay tuned as the competition heats up. ■

tures that the program cannot handle. In testing, it could not create an extended memory cache in the test system. Instead, it cited not enough memory, even though 8MB of extended memory was installed in the system. There was not a problem transforming the cache from expanded memory.

Should you still encounter difficulties with DR DOS 5.0 despite its automatic setup and internal help, Digital Research maintains a telephone support service. Although the number is not toll-free, Digital Research adds no extra charge for support (unlike support through "900" telephone numbers).

ONE FOR THE ROAD

DR DOS 5.0 is not designed exclusively for individual users. It also has some unique features designed to charm computer manufacturers. These benefits are particularly important for portable PCs, in which DR DOS 5.0 can extend battery life and keep a larger amount of the 640K of DOS memory free by executing its operations in ROM. In addition, the CURSOR utility makes LCD screens a little more readable.

BatteryMax is proprietary Digital Research technology designed to help battery-powered computers run longer on a single charge. The concept is simple: The operating system monitors the programs that are running under it to determine when they are doing something important (like calculating) and when they are idle. In idle moments, it can cut back on the speed of the microprocessor or even shut it down entirely, conserving the valuable watts that would otherwise be wasted waiting for the keystroke that never comes.

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OPERATING SYSTEMS

DR DOS 5.0

According to Digital Research, BatteryMax can prolong the time until total battery discharge by a factor of two or three. A battery that now lasts long enough to work through a shuttle flight between New York and Washington D.C., could last long enough to complete a lengthy transcontinental flight.

Like everything that sounds as good as BatteryMax, the feature comes with a string attached. Getting it to work requires specific hardware support, a control port through which the operating system can slow down or halt the microprocessor. That means a computer has to be built specifically to take advantage of BatteryMax. Just opting for DR DOS 5.0 instead of MS-DOS won't save you a single joule on the laptop you use to do your work today.

Digital Research is currently working with the manufacturers of laptop computers to implement the hardware hooks necessary to make BatteryMax work. According to the company, all laptop vendors are evaluating it. Seven U.S. vendors have licensed the technology, in addition to a comparable number in Europe and the Pacific Rim, although no

products were available for evaluation at the time of this review. No existing computers can benefit from this important new technology.

The true value of the ROMable kernel of DR DOS 5.0 lies in the future. It, too, requires a computer specially built to take advantage of it. The only alteration necessary to be made on a current model is adding either another or a larger ROM chip to the system.

Although getting the most from these advanced features of DR DOS 5.0 remains in the future, the operating system has already delivered its greatest benefit. DR DOS 5.0 is an alternative to MS-DOS that you can buy today. It raises the issue of competition, a scary specter for a sole-source operating system vendor grown fat over the last decade, but a welcome addition to your choices as a consumer of DOS-based products.

DR DOS 5.0 has no major drawbacks. While you may not want to spend an extra \$199 for an operating system, there's no reason to look askance at a PC that comes equipped with it.

DR DOS 5.0 has no major drawbacks. While you may not want to spend an extra \$199 for an operating system, there's no reason to look askance at a PC that comes equipped with it.

DR DOS 5.0 is a completely competitive operating system built on an aggressive philosophy that promises to force innovation. In a stodgy software world that has changed only reluctantly, this technological breath of fresh air is certainly refreshing.

Winn L. Rosch is a contributing editor of PC Magazine.

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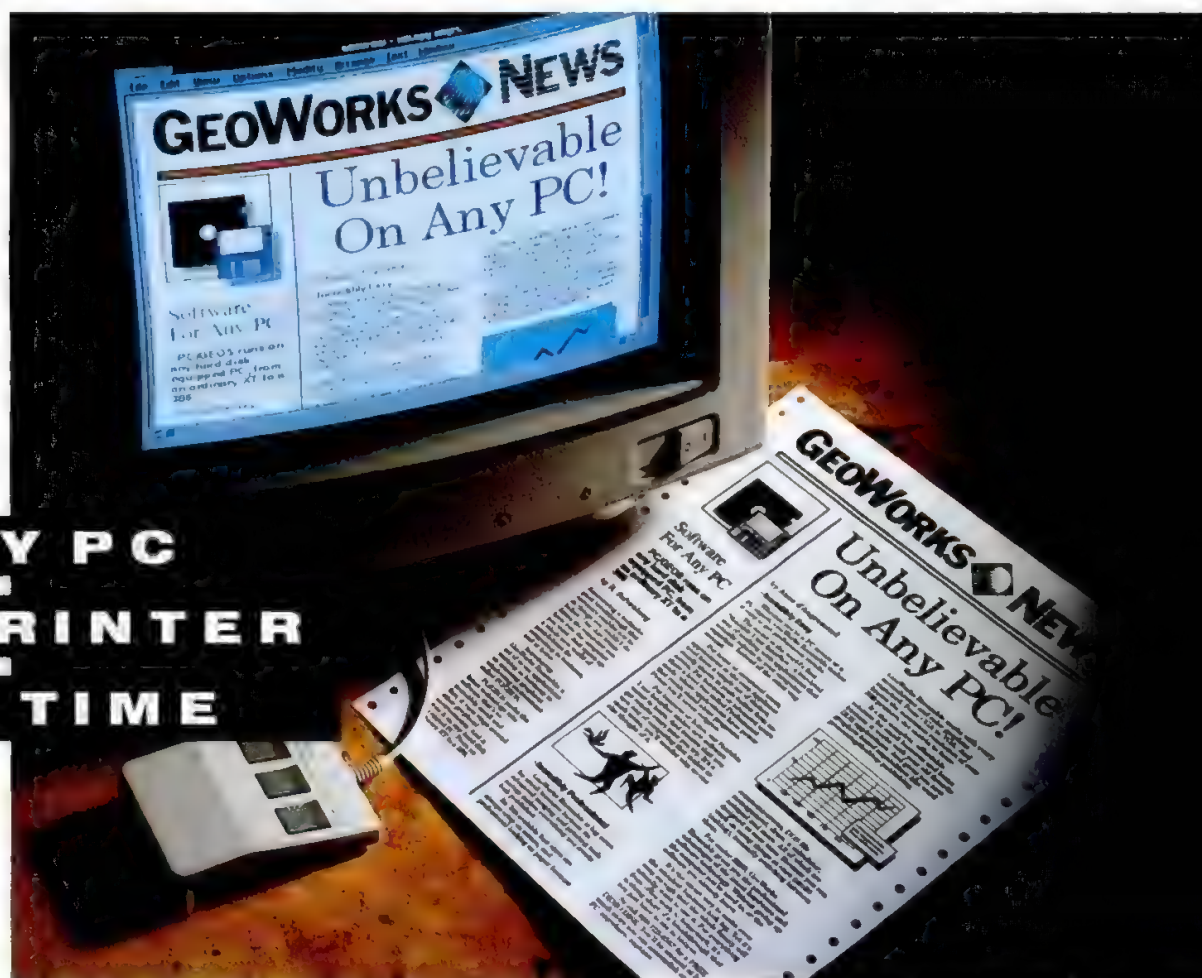
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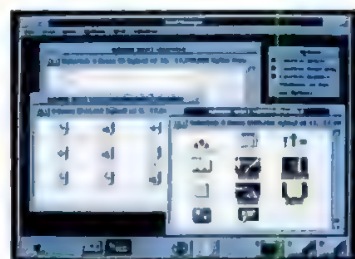
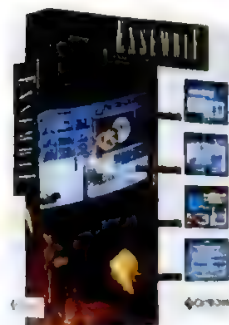
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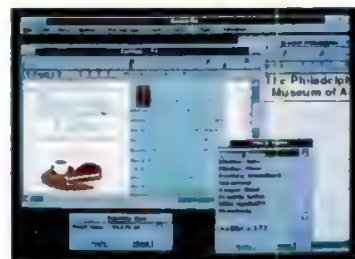
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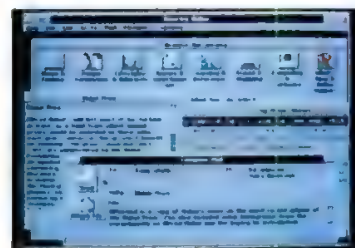
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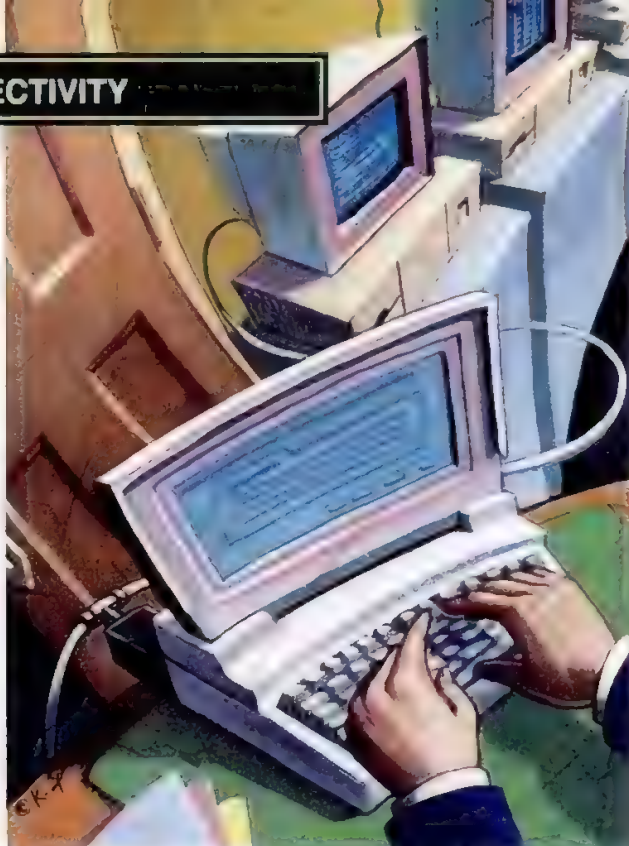
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These three portable external LAN adapters bring the power of a local area network to your laptop computer, letting you get connected quickly without installation hassles. And you can use them on your overloaded desktop PC, too.



BUILDING WORKGROUP SOLUTIONS

EXTERNAL LAN ADAPTERS

BY KIMBERLY MAXWELL



When we think of portables, we think small: small computer, small screen, small everything. But small doesn't mean less powerful. Portable computers rival their bigger brothers in processing power and storage capacity, and in many organizations it is just as important for them to be connected to LAN resources. Unfortunately, vendors have neglected connectivity for portables until recently.

CONNECTIVITY

EXTERNAL LAN ADAPTERS

In early 1989, Xircom developed a convenient way to integrate a portable computer into a network environment. Xircom's Pocket LAN Adapter uses the parallel printer port on a laptop computer (or, for that matter, a desktop PC) to link the machine to the network cable. All the hardware stays outside the PC. Software supplied with the external adapter routes network data in and out of the parallel port.

From the beginning, such devices were given a name that didn't really fit their use but characterized their size and physical configuration. By calling its original product a Pocket Ethernet Adapter, Xircom conjured up images of a device that buyers could slide into a coat pocket, take on the



EDITORS' CHOICE

• p.LAN

Each of the external LAN adapters we tested worked well, but one product clearly stood out from the rest. IQ Technologies' p.LAN lacks the complete portability of the D-Link and Xircom pocket LAN adapters, but we think that most people are more interested in making easy connections than portable ones.

Connecting with the p.LAN is easy. It's a dependable device that hooks up to your portable or desktop PC via a short cable, which means that you can place it either next to or on top of your machine. It doesn't dictate the physical positioning of your laptop or PC. Additionally, the p.LAN connects you to a network while still permitting the use of a parallel printer via the printer port on its back panel. Its front-panel indicator lights prove helpful in providing diagnostic and status information about the p.LAN itself, the PC to which it is connected, and network activity. What's more, the product outperformed its competition on our benchmark test.

A word about Xircom's Pocket LAN Adapter: It was the first of the external LAN adapters, and its innovation and design earned it a *PC Magazine* award for Technical Excellence. Both DLink and IQ Technologies have obviously benefited from Xircom's pioneering work, as evidenced by these companies' well-rounded products.



SUMMARY OF FEATURES: EXTERNAL LAN ADAPTERS

Products listed in ascending price order

	D-Link Systems Inc. D-Link Ethernet Pocket LAN Adapter	Xircom Xircom Pocket LAN Adapter	IQ Technologies Inc. p.LAN
List price:			
Ethernet version (tested)	\$495	\$595	\$695
Token-Ring version	N/A	\$845	\$950
ARCnet version	N/A	\$345	\$495
10BaseT twisted-pair version	\$495	N/A	\$795

DRIVER SOFTWARE INCLUDED

Advanced NetWare 286	■	■	■
NetWare 386	■	■	■
NDIS	■	■	■
NetBIOS	■	■	■
TCP/IP	■	■	■
3+Share	■	■	■
VINES	□	■	■

Other compatible systems	DECnet DOS, LANsmart, Nexos, PC LAN, PC-NFS	CocoNet, DECnet/PCSA, LANtastic, Net/One, PC LAN, PC-NFS, PC/NOS, StarGroup	DECnet, LAN Manager, LANtastic, MS-Net, Net/One, OS/2, PC LAN, PC-NFS, PC/TCP, POWERlan, WIN/TCP
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MISCELLANEOUS

Indicator lights:			
Power-on lights	■	□	■
Diagnostic lights	□	□	■
Extra parallel port	□	Optional (\$95)	■

■—Editors' Choice ■—Yes □—No
N/A—Not applicable: No such version is currently available.

road, and use for attaching a laptop to the Ethernet cable in their hotel rooms. Actually, many external LAN adapters stay on the desktop when their host PCs go traveling. But the portability and interchangeability of external adapters do allow technical troubleshooters, auditors, and other business travelers to connect to a wide variety of network environments as they make their appointed rounds.

External LAN adapters can be useful for any PC without an open expansion slot. In addition, they give a PC quick access to a network without requiring users to select the proper IRQ and memory addresses or to solve the other problems that typically arise whenever you install internal LAN adapters.

REVIEW CRITERIA

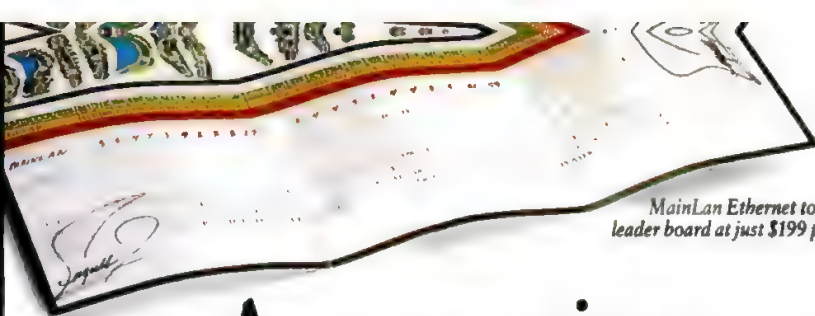
In this review, *PC Magazine* evaluates three external LAN adapters that can connect to the parallel port of a portable or desktop personal computer. In all cases,

we tested the "thin Ethernet" models of these adapters.

In addition to Xircom's Pocket LAN Adapter, we tested the p.LAN from IQ Technologies and the Ethernet Pocket LAN Adapter from D-Link Systems. Another company, Accnet Technologies, couldn't get its new external LAN adapter to us in time for this review. Likewise, CNet Technology's Pcket Ethernet LAN Adapter, which should be available by the time you read this, was not shipping in time for the review.

The D-Link and Xircom adapters are similar in size, but the IQ product is somewhat larger and heavier and sits apart from the PC. Its size allows room for indicator lights showing the status of the PC, the network, and the device.

The products we tested range in price from \$495 to \$695. In general, external Ethernet adapters cost about \$300 more than comparable internal models; Token-Ring versions, about \$600 more.



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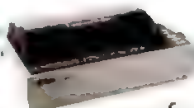
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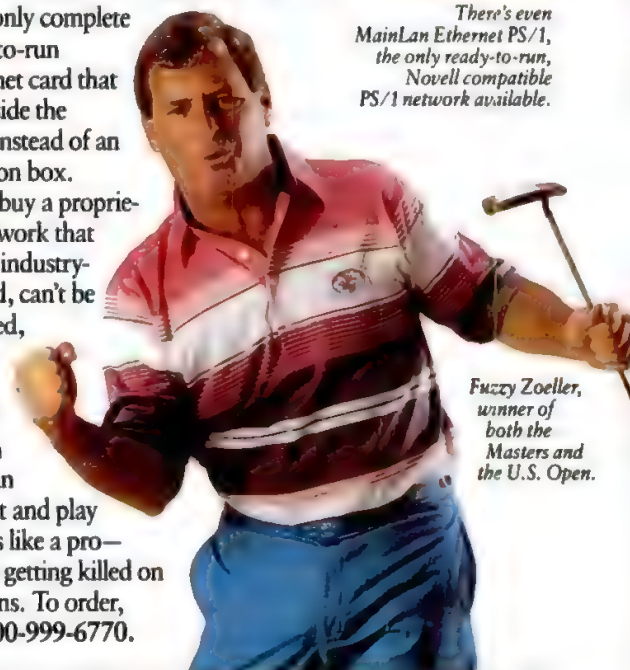
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The Pocket LAN Adapter



Product of the Year—Portable Networking 1989

"It's the perfect way to link portables to a LAN."



Best of Show—Fall Comdex 1989

"Makes it vastly easier to connect systems—especially portables—to LANs."



Product of the Year 1989

"Xircom's Pocket LAN Adapter is a simple solution to a nagging problem."



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CONNECTIVITY

EXTERNAL LAN ADAPTERS

VERSATILITY AND LIABILITIES

The companies marketing external adapters offer their devices in different models for various network cabling schemes. You can buy adapters for ARCnet, thick and thin Ethernet wiring, 10BaseT, and Token-Ring. The adapter companies provide software drivers for a variety of networks, including *LAN Manager*, *LANtastic*, *NetWare*, TCP/IP, and *VINES*.

As useful as these products are, they do have certain drawbacks—primarily impaired speed and the potential loss of a parallel port. Throughput degrades to about

The external LAN adapters we review here can be useful for any personal computer without an open expansion slot.

25 percent of what you would expect from an internal network adapter in the same computer. An external adapter gives you throughput of about 250 kilobits per second on an AT-class PC; on a fast 386- or 486-class computer, it allows you to attain network throughput of over a megabit per second.

Because the external adapters attach to the parallel port, on most PCs they take up the only connection available for a parallel printer. But two of the manufacturers, IQ Technologies and Xircom, offer a way to continue using that port. IQ's p.LAN adapter includes a printer pass-through feature that lets you use the printer and the network at the same time. Xircom offers an optional \$95 parallel port multiplexer that can do the same thing for its Pocket LAN Adapter.

Bear in mind that the PC's parallel port doesn't have the capacity to carry heavy network traffic and a large print job simultaneously. In practice, the application sending the print job must defer to the network traffic going through the parallel port when both the external adapter and a printer occupy the same connection.

Because computer manufacturers implement their parallel port hardware in dif-



BENCHMARK TESTS: EXTERNAL LAN ADAPTERS

The parallel port connection that these external LAN adapters use limits their maximum throughput, but all the units are fast enough to handle any but the most intense LAN jobs.

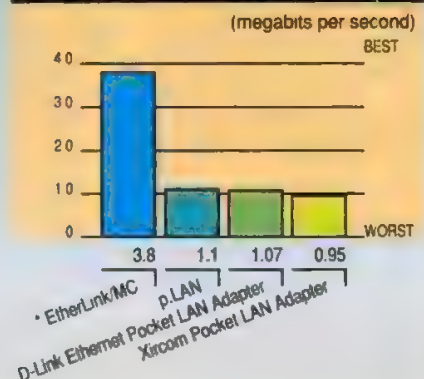
PC Magazine LAN Labs' benchmark tests are written in C and are independent of commercial software. We ran the Network Throughput test using the same server, workstations, and cabling each time.

The server was a Samsung 386A3, a

33-MHz 80386-based system, with 8MB RAM. It ran Novell's *NetWare 386*, Version 3.1. We tested the thin Ethernet model of each adapter, connected to an NCR PC486/MC33 workstation running an 80486 processor at 33 MHz.

The **Network Throughput** benchmark test moves data between the workstation and the server by means of the external LAN adapter; the test involves a sequential read, a sequential write, a random read, and a random write of a 1MB file on the server. The record sizes used in these activities systematically rotate among 16K, 4K, and 512 bytes. We report each adapter's throughput in megabits per second.

Network Throughput



* Reported for comparison.

When we tested these external LAN adapters, we wanted to insure that the throughput of the PC we used in the test would not be the limiting factor. We chose an NCR PC486/MC33 as the client PC because we knew it would stretch the adapters to their limits.

Driven by the power of this computer, all of the external adapters provided throughput at or near a megabit per second. This kind of throughput is sufficient for practically any network task. But in an MCA, ISA, or EISA machine, the parallel port simply cannot provide the same throughput as an adapter inserted in the expansion bus. Overall, the throughput of an external adapter amounts to only about one-third of what the same PC can move through the network using a top-of-the-line 3Com EtherLink/MC, a Micro Channel Ethernet adapter (which we also tested for comparison).

In comparing the performance scores for the three external adapters, note that the driver software typically accounts for the major differences in throughput. Although the parallel port acts as the

constricting factor, the software controls the parallel port. Since we found only small differences in throughput, the ranking shown here may alter with the next release of a vendor's driver software. Among the units we tested, IQ Technologies' p.LAN held a slight lead over the other external adapters.

We ran the same throughput test with both the p.LAN and the Xircom Pocket LAN Adapter while we used a background program to send a print job to the local printer ports available with these units. In both cases, the output of the print job ceased while network traffic was present, and the print job made no difference in the throughput on the network.

At PC LAN Labs, we couldn't fully measure one important factor: the compatibility of these units with every popular laptop and desktop PC. We tried them on several Toshiba laptops in the 1000/1100 series and on an NEC Pro-Speed 386SX without encountering any problems. But if you have a nonstandard PC, you should ask the adapter manufacturer about compatibility.

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-Computer Monthly,
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-InfoWorld,
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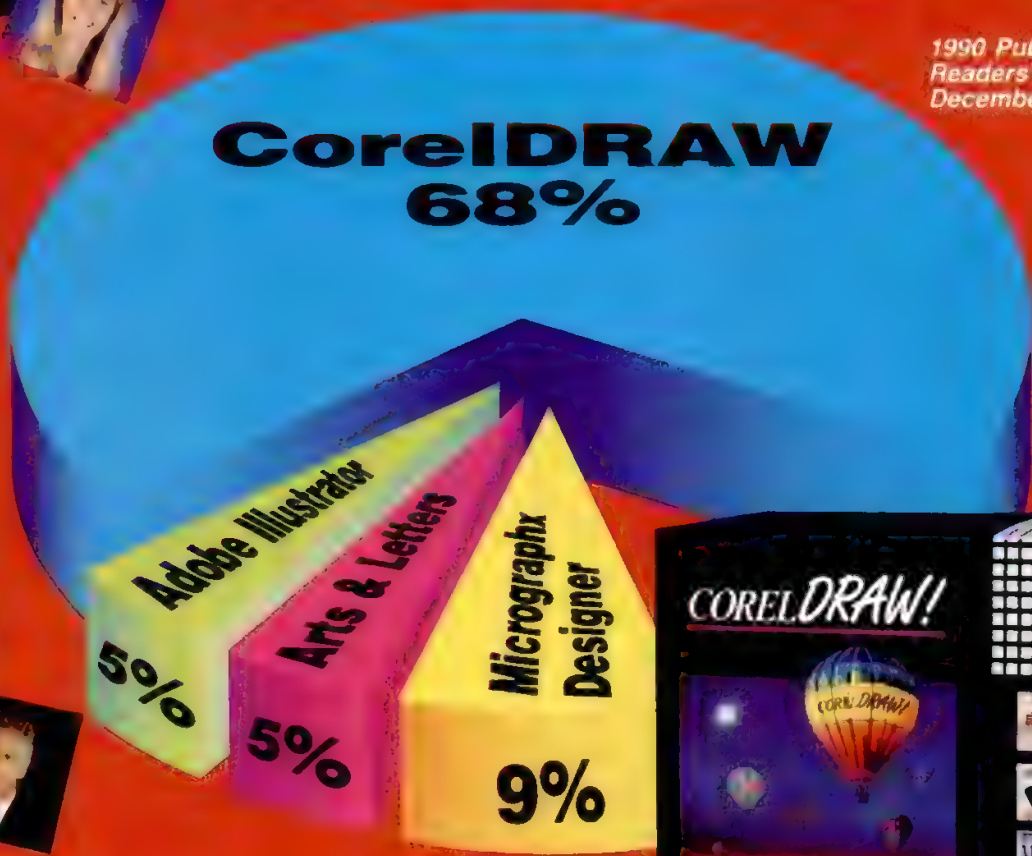
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CONNECTIVITY

EXTERNAL LAN ADAPTERS

ferent ways, compatibility between the external LAN adapter and the PC is potentially a problem. The vast majority of PCs will work with each of the products we review here, but if you want to use an external adapter on a computer that isn't widely marketed, it's a good idea to make a quick call to the adapter's manufacturer to check on compatibility.

THE ZERO-SLOT LAN ALTERNATIVE

External LAN adapters aren't the only solution for linking portable PCs to LANs. Sometimes the network connection for a laptop can be indirect. You can connect a laptop or portable to a PC that is already networked by using available parallel or serial ports and a product we call a zero-slot LAN (see "Building Workgroup Solutions: Zero-Slot LANs," *PC Magazine*, April 24, 1990). Rather than attaching the laptop directly to the network, you use another networked PC as a network gateway for the portable. Artisoft, the Software Link, and Traveling Software, among others, sell zero-slot LAN products.

The software in the zero-slot LAN lets a drive or printer on the networked PC appear as a local drive or as an LPT port on the portable's screen. The distant drives that now appear local are called virtual drives. The drives on the networked PC are redirected from the file server.

For example, assume that a networked PC has the DOS drive letters F:, M:, and Y: assigned to virtual drives on the network file server. The laptop attached to the networked PC through a zero-slot LAN can use the same virtual drives as if they were its own. Because of the zero-slot LAN's speed limitation, this connection works best for transferring small files, sharing printers, and using electronic mail. While an external Ethernet adapter also produces slower throughput than an internal model, the speed degradation isn't nearly as much as with a zero-slot LAN, making it more practical for applications such as file sharing in network database programs. In addition, the zero-slot LAN does not offer as much security as a direct LAN connection, although it works effectively in many applications.

INTERNAL ALTERNATIVES

Companies such as Megahertz Corp. and Pure Data provide another laptop-to-LAN solution: network adapters that can slide into the modem slot on a few portables. If you decide to take this route, you either give up your modem communications to

gain network capabilities or you swap the network adapter for the modem every time that you leave the office. Exchanging the LAN adapter for a modem isn't an easy task unless the portable is roomy enough to provide an extra open slot. With an external LAN adapter, you don't need to worry about the slots.

Some Toshiba portables on the market already include an internal network adapt-

In many cases,
external LAN adapters
provide the only
viable way to bring a
laptop into a LAN.

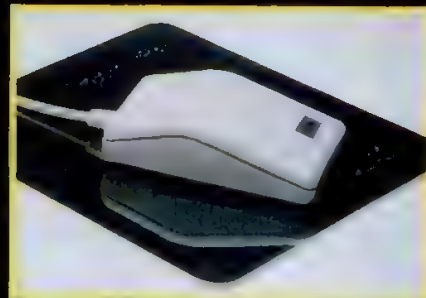
er, but such adapters are made primarily for thin Ethernet networks. Conversely, Xircom, IQ Technologies, and D-Link sell external LAN adapters for a wide variety of networks.

Connect Computer Co.'s WonUnder provides another solution: an external cabinet that you attach to the underside of a laptop or notebook computer, the WonUnder accepts any type of PC expansion card—including a network adapter—and works with many laptop models. The WonUnder sometimes offers the only way to give a laptop certain capabilities, such as 3270 coaxial connections to a mainframe, but its design detracts from your machine's portability. You need a special version of the WonUnder for each type of laptop you use, and often it prevents you from using an internal modem. The WonUnder needs to make an electrical link with a connector inside the computer, usually the same one used by the modem.

Zero-slot LANs, internal laptop adapters, and the WonUnder offer workable solutions to the problem of attaching a portable computer to a network. Yet our testing and reviews prove that external adapters supply an effective way to link laptops and other computers into networks while avoiding the disadvantages of these alternative schemes. In many cases, external LAN adapters provide the only viable way to bring a laptop into a LAN.

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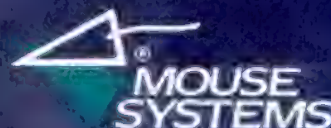
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CONNECTIVITY

EXTERNAL LAN ADAPTERS

D-LINK SYSTEMS, INC.

D-Link Ethernet Pocket LAN Adapter

All reviews by Kimberly Maxwell

Do you need to get into the network using your laptop computer so you can check your e-mail or download data? If so, you can attach D-Link Systems' Ethernet Pocket LAN Adapter to your portable (or desktop) PC and begin using your network resources within minutes. Since you don't have to configure the device, you'll find that getting it up and running is simpler than installing an internal network adapter inside your computer.

Installation consists of simply connecting the D-Link Pocket LAN Adapter directly to the parallel port of your PC and then attaching the network cable to the adapter's network connector. Be sure to note, however, that this means that you will lose the use of a parallel port while the Ethernet Pocket LAN Adapter is attached. At this time, D-Link Systems does not of-

fer an option to allow the use of the parallel port for local printing while the external adapter is attached.

This self-contained, half-pound adapter comes in three Ethernet models, each selling for \$495—which is less than the list price of the competing Ethernet products. D-Link markets adapters for thick Ethernet (with an AUI connector), thin Ethernet, or 10BaseT Ethernet. Each adapter comes with software for a full range of network operating systems including DECnet DOS; *LANsmart*; NDIS; NetBIOS-compatible software; *NetWare Advanced 286*, Version 2.x, and *Netware 386*, Version 3.x; *Nexos*; *PC LAN*; *PC-NFS*; *PC/TCP*; and *3+Share*.

GOOD THROUGHPUT

Our testing of the thin Ethernet version of the adapter went as smoothly as possible. After we created an IPX driver for the adapter following the standard *NetWare* SHELGEN procedure, we proceeded to connect the thin Ethernet cabling on our *NetWare 386* network to the device's BNC



D-Link Ethernet Pocket LAN Adapter

D-Link Systems Inc., 5 Musick, Irvine, CA 92718; 714-455-1688.

List Price: AUI, BNC, or 10BaseT twisted pair versions, \$495.

Requires: 256K RAM, parallel port.

Compatible With: DECnet DOS; *LANsmart*; NDIS; NetBIOS-compatible software; *Advanced NetWare 286*, Version 2.0 or later, or *NetWare 386*, Version 3.0 or later; *Nexos*; *PC LAN*; *PC-NFS*; *PC/TCP*; *3+Share*; and others.

In Short: The Ethernet Pocket LAN Adapter's simple installation and protective carrying case make it convenient if you're on the go. The device uses the company's own DL3511 single-chip Ethernet controller. It proved second-fastest among the adapters we tested, but it does not provide for the loss of a parallel printer port.

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CONNECTIVITY

EXTERNAL LAN ADAPTERS

connector. The software automatically configured the LPT port and we were off to the races.

The AC power supply included in the package powers the LAN adapter, so it doesn't take power from your PC. The power supply automatically detects the input voltage, which means that you can use the device internationally without having to purchase special power supplies for different voltages.

The adapter contains D-Link's own DL3511 single-chip Ethernet controller. D-Link says that this chip's improved performance and size give the adapter a boost in speed. During our performance tests, we found the Ethernet adapter's throughput rate placed it in the middle position among the three external LAN adapters.

D-Link's designers show concern for the accountant or the technician out on the road who needs to connect a desktop or laptop PC to a network in another location. D-Link not only makes installation simple; it also packages the adapter in a special pouch so that the device doesn't get damaged during travel. Additionally, the installation guide fits snugly inside the pouch

D-Link not only makes installation of its Pocket LAN Adapter simple; it also packages the device in a special pouch so that it doesn't get damaged during travel. The installation guide fits snugly inside the pouch.

for handy reference.

If you are considering buying an external local area network adapter, then check into D-Link's Ethernet Pocket LAN Adapter. The compact size, good performance, and easy installation of this product are good reasons for using it to connect your laptop or desktop PC to a network.

IQ TECHNOLOGIES INC.

p.LAN

IQ Technologies swaps a little portability for a lot of flexibility. The p.LAN adapter weighs 1 pound—twice as much as the competing D-Link and Xircom products—and at 6.5 by 5.8 by 1.5 inches, IQ's attractive gray box is bigger than its competitors. That's okay, since this device is intended more for desktop operation than on-the-road portability.

D-Link's and Xircom's smaller, external Ethernet adapters attach directly to the PC's parallel port with no intervening cable. This type of connection takes up space

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CONNECTIVITY

EXTERNAL LAN ADAPTERS

FACT FILE

EDITOR'S CHOICE



p.LAN

IQ Technologies Inc., 22032 23rd Dr. SE, Bothell, WA 98021; 800-752-6526, 206-483-3555.

List Price: ARCnet, \$495; Thin Ethernet or thick AUI connection, \$695; 10BaseT, \$795; Token-Ring, \$950.

Requires: 256K RAM, parallel port.

Compatible With: Microsoft's LAN Manager and MS-Net, LANtastic, Advanced NetWare 286 and NetWare 386, OS/2, PC LAN, TCP/IP, 3+ Open and 3+ Share, and VINES. Under Ethernet: DECnet, Net/One, PC-NFS, POWERlan, and WIN/TCP. Under Token-Ring: NetBIOS and PC/TCP.

In Short: p.LAN is designed more for stay-at-home duty than lightweight travel. It offers a simple physical connection, a local parallel port, and special diagnostic features. The local parallel port lets you keep a parallel printer connected, and the p.LAN's throughput outruns the other units.

CIRCLE 603 ON READER SERVICE CARD

in back of the PC (in D-Link's case, you also lose the use of a printer port). IQ Technologies' p.LAN connects through a short cable, allowing you to place the external adapter next to or on top of the computer, just like an external modem. That allows a clear view of the p.LAN's front panel, which provides diagnostic and status information on the adapter, computer, and network.

Additionally, the p.LAN has a printer port on its back panel, so you don't lose your parallel printer connection when the external adapter is installed. Simply connect the printer directly to the adapter. This feature provides you with access to both the network and to a printer, and it allows you to perform transparent printing tasks using commands from either DOS or your applications. Every time that you turn on the p.LAN box, it enables the printer port.

In testing, when we tried to use the p.LAN adapter to carry simultaneous network and printer traffic, the printer traffic yielded to the network traffic. This is the best logical solution.

The p.LAN connects through a short cable, allowing you to place the adapter next to or on top of the computer, just like an external modem.

THREE CHOICES

You can choose from several different versions of p.LAN. The ARCnet and Token-Ring versions sell for \$495 and a pricey \$950, respectively. The \$695 thin Ethernet version, which we tested, has a standard BNC connection; the thick Ethernet version sells for the same price but has an AUI connection on the back panel of the box. The 10BaseT version sells for \$795.

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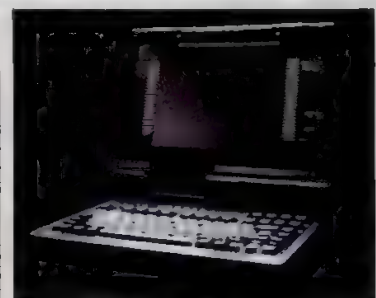


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THE LAP MASS

PC WEEK POLL: 386SX-BASED LAPTOP/PORTABLE COMPUTERS

	Overall Weighted Score	Standard Software Compat.	Display Quality	Overall Reliability	Overall Performance	Keyboard Quality	Product Support Quality	Repair Service Availability	Value Relative To Cost	Overall Functionality As Compared To Desktop PCs	Brand Level Hardware Compat.	Product Support Access	Quality of Document
Dell System® 316LT	1st	1st	2nd	1st	1st	1st	1st	1st	1st	1st	1st	1st	1st
Toshiba T2100SX	2nd	2nd	1st	2nd	2nd	2nd	3rd	2nd	2nd	2nd	2nd	2nd	2nd
Zenith SupraPort SX Model 40	3rd	3rd	3rd	3rd	3rd	3rd	2nd	3rd	3rd	3rd	3rd	3rd	3rd



It wasn't very pretty.

Last July, a computer company from Austin, Texas annihilated the competition in the PC Week Corporate Satisfaction Poll for 386™ SX based laptops.

In fact, the Dell laptop handily beat the Toshiba laptop in 11 out of 12 categories. And Zenith in all 12.

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CONNECTIVITY

EXTERNAL LAN ADAPTERS

IQ Technologies uses the Intel controller chip in the Ethernet versions of the device. Each adapter comes with software and an AC power supply, so it doesn't take up any of the PC's power.

The p.LAN device for Ethernet and Token-Ring networks supports a variety of network operating systems, including *LAN Manager* and *MS-Net*, *LANtastic*, *NetWare 286* and *NetWare 386*, *OS/2*, *TCP/IP*, *3+Open* and *3+Share*, and *VINES*. The ARCnet version of the device supports *NetWare 286* and *386*.

EASY INSTALLATION

Don't set aside a lot of time to install the product on your network, because physically installing the p.LAN takes less than a minute. You connect the thin Ethernet unit to your PC's parallel port using the attached 17-inch cable, connect the network cable using the device's BNC connector, and create the appropriate network driver (in our case, a *NetWare* IPX driver) so that the network will see the device as an interface between the laptop and the network.

You don't have to perform any special tasks to configure the device for the network. The drivers automatically configure to the appropriate parallel printer port. If you don't know how to create an IPX driver for the adapter, the manual goes into detail on creating drivers for Novell networks. Running p.LAN and the network drivers requires about 26K RAM.

The p.LAN adapter has a built-in diagnostic test that runs each time you use the driver software. This special feature makes you aware of any problems with the adapter before the software tries to link to the network. You can also find out whether the parallel port interrupts are properly configured, whether there are any shorts or openings in the cabling, and whether there is a viable link to the network operating system.

The four front-panel indicator lights also verify proper connections among the device, the computer, and the printer attached to the p.LAN. The printer mode light tells you of data transferred to the printer from the computer. You can find out whether the adapter and the Novell driver software are ready to process the communications between the computer and the network, and you can monitor computer and network activity.

While the p.LAN is small enough to fit comfortably in a briefcase, it is primarily meant to provide a home port for your laptop or a network connection for a loaded

While IQ Technologies' p.LAN device is small enough to fit comfortably in a briefcase, it is primarily meant to provide a home port for your laptop or a network connection for a loaded PC.

PC, rather than for road work. A versatile product that gave top performance on our throughput test, p.LAN offers the additional advantages of diagnostic facilities and a parallel printer connection. Its good performance and these appealing extras combine to make this a product worthy of your attention.

XIRCOM INC.

Xircom Pocket LAN Adapter

Xircom's Pocket Ethernet Adapter was the first external network adapter to reach the market. In 1989, Xircom proved there was a way to integrate portable computers or desktop units into an Ethernet network environment without using the expansion slots in a computer. In the earliest versions of the Pocket LAN Adapter, its support was limited. Now Xircom's adapter supports *NetWare* and a variety of other networks, and the company also markets ARCnet and Token-Ring versions of the Pocket LAN Adapter.

Xircom supports practically every possible combination of wiring and network operating system. Xircom's Ethernet

product sells for \$595 and is compatible with *Advanced NetWare 286* and *NetWare 386*, *CocoNet*, *DECnet PCSA*, *LANtastic*, *NDIS*, *NetBIOS*, *NetOne*, *PC LAN*, *PC-NFS*, *PC/NOS*, *StarGroup*, *TCP/IP*, *3+Share*, and *VINES*. This product comes in thin Ethernet, 10BaseT, and external MAU versions. The ARCnet version costs a low \$395, and the Token-Ring adapter—based on IBM Token-Ring hardware standards—sells for a relatively high \$845.

If you don't want to lose your PC's parallel port to the Xircom adapter, you can purchase a parallel port multiplexer from Xircom for \$95. This device gives you two parallel ports, so you can connect your Xircom adapter to one port while connecting a printer to the other. You can also use the parallel port multiplexer to attach two parallel printers when you're not using the Xircom.

Unfortunately, the PC's parallel port is hard-pressed to provide the throughput needed to make a network connection. If you try to push a print job through the same port while there is heavy network traffic, something's got to give. During our testing of the parallel port, we found that the print job stopped to let the network traffic through (the same was true of IQ's p.LAN). This is a wise configuration, because the stream of network data is usually much shorter than the stream of print job data.

If you don't want to lose your PC's parallel port to the Xircom device, you can buy Xircom's parallel port multiplexer.

SUPPORT AND INSTALLATION

Each version of Xircom's Pocket LAN Adapter comes with a set of drivers for a wide range of network operating systems. The Token-Ring model is compatible with *Lantastic*, *NetBIOS* networks, *Netware 286* and *NetWare 386*, and *PC LAN*, among others. By contrast, Xircom's



Sometimes it's just not prac

tical to run a cable

from a computer to a printer.



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Meet a genuine breakthrough: the Verran AC Datalink. It lets you connect virtually any computer to a printer. Or a modem. Or a plotter. Or a terminal. All *without cables*. The connection takes place through your building's electrical wiring and works at distances of 300 feet or more.

Think of it. No more torn-up offices, expensive wiring solutions, or cabling headaches. The Verran AC DataLink is the perfect answer for quick connections between computers and peripherals—even if they're in different offices.

The applications are numerous—from office moves to demonstrations to special needs for temporary staff. You can even connect extra terminals to a larger computer without cabling—a feature which can be invaluable when additional programmers come on board.

There's no software required. A pair of AC DataLinks is all you need. Just connect one to your computer and one to a peripheral. Then plug each into a standard electrical outlet. That's it. You're up and running in minutes.



The AC DataLinks take care of everything: error correction, translation when needed, even adaptors for parallel (Centronics) or serial (RS-232) connections. So you can enjoy virtually universal compatibility between computers and peripherals—even use a parallel printer from a serial port! You can also select an encryption code for each pair of AC DataLinks, providing a high level of data security.

And here's another breakthrough from Verran: the AC DataLink DPS (Dedicated Printer Sharer) which allows up to seven computers connected to AC DataLinks to share the same printer. It's like having a printer for each computer—at a fraction of the cost.

Status and queuing information is provided by the AC DataLinks, so you'll enjoy more efficient printer use than ever before. The AC DataLink DPS is suitable for any printer with a parallel port.

Want to free yourself from the ties that bind? See your local computer dealer to learn more about Verran AC DataLink products. Or contact GEC-Marconi for more information.

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Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

CONNECTIVITY EXTERNAL LAN ADAPTERS

ARCnet model runs only on *LANtastic*, NetBIOS networks, and *Netware 286* and *NetWare 386*.

One software enhancement, the network device interface specification (NDIS), gives those running *LAN Manager* and *VINES* an opportunity to run any version of the Xircom adapter on the network. The NDIS driver comes in both DOS and OS/2 versions. With TCP/IP support, an adapter can connect the PC to minicomputers and mainframes that use a wide range of operating systems.

Once you attach any of the Pocket LAN Adapters to your PC's parallel port, you must install the diagnostics program included on the Xircom Network Drivers disk and create the appropriate network driver for the adapter (for us, it was a *NetWare IPX* driver). Since the device is self-contained, you don't have to configure any on-board switches. A power supply comes with the adapter to help avoid

Xircom has been able to keep improving on its original design, doing everything from introducing new versions of the device to increasing network support by including more network drivers in the software.

overloading the PC's power supply.

The diagnostic program, PETEST, gives you information about your parallel port configuration, as well as the serial number of the adapter. It also performs several tests, including a Loopback test for transmission capability and an EEPROM test of the on-board memory. It also tells you if the Ethernet Controller integrated



Xircom Pocket LAN Adapter

Xircom Inc., 22231 Mulholland Hwy., #114, Woodland Hills, CA 91364; 800-874-7875, 818-884-8755.

List Price: ARCnet, \$395; Ethernet, \$595; Token-Ring, \$845. Parallel Port Multiplexor, \$95.

Requires: 256K RAM, parallel port.

Compatible With: Advanced NetWare 286, Version 2.0a or later, and NetWare 386, Version 3.0 or later; *CocoNet*; *DECnet PCSA*; *LANtastic*; *NDIS*; *NetBIOS*; *Net/One*; *PC LAN*; *PC-NFS*; *PC-NOS*; *StarGroup*; *TCP/IP*; *3+ Share*; *VINES*; and others.

In Short: Xircom entered the external LAN adapter business first, and it offers adapters for nearly every type of wiring and operating system. The family of adapters offers slower throughput than the competition, but its wide-ranging support base makes Xircom a good choice. The optional multiplexer lets you keep a parallel printer connected.

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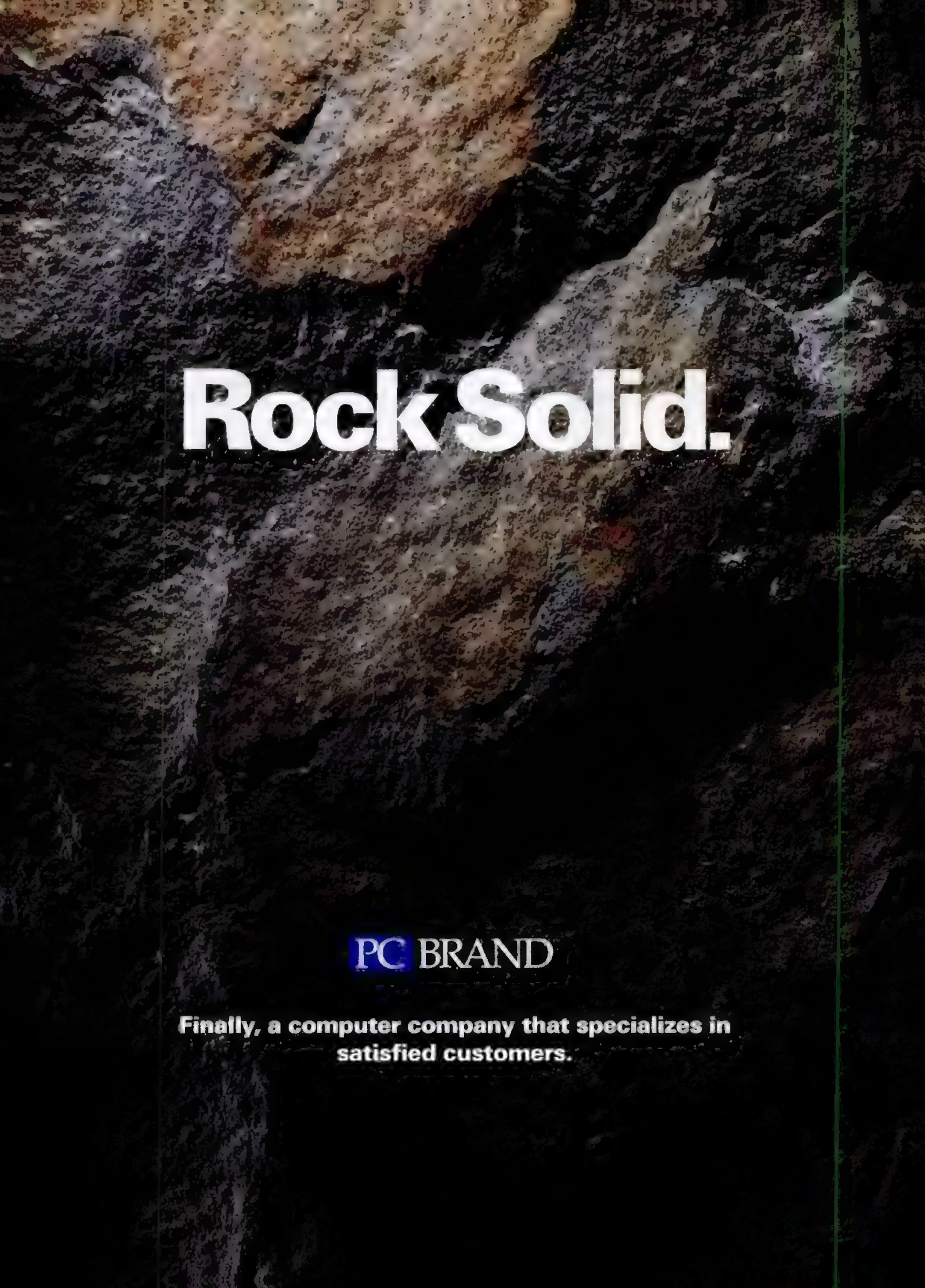
circuit failed to initialize, and it checks data packets.

The manual gives you a guide on each network driver's installation, and its troubleshooting section is helpful for those times when you're attempting to identify problems with the adapter.

Xircom's Ethernet adapter didn't perform quite as well as the other products on our throughput test. Still, the throughput was adequate for network tasks.

Having the first product of its kind on the market gave Xircom an edge in the industry. The company has been able to keep improving on its original design, doing everything from introducing new versions of the adapter to increasing network support by including more network drivers in the software. Xircom has solved many compatibility problems and equally important, its products enjoy a broad base of support. While it's not the fastest adapter among the three we reviewed, the Pocket LAN Adapter certainly has the additional appeal of proven reliability and a well-packaged presentation. ■

Kimberly Maxwell is a frequent contributor to PC Magazine.



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-Computer Monthly, PC Brand 286/16 Product Review

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- 1 Parallel and 2 Serial Ports
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Standard Features Cont.

- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, NOVELL.3COM, and PCNET compatibility
- Built in System Board LIM 4.0EMS hardware
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- Mini Tower
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-Computer Buyer's Guide, 386SX-16 Product Review

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- 1.2 MB or 1.44 MB Floppy Drive
- 101 Key Click/Tactile Keyboard
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SX-16 **\$799**

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- 8 Slot Motherboard Design (5 16bit and 3 8bit)
- Medium Footprint Desktop Case with 6 Disk Drive Bays

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- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
- 320MB/16MS
- 640MB/16MS

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-PC Magazine, 386/25 product review

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- 1MB RAM expandable to 16MB on the System Board
- 1:1 Interleaving Hard /Floppy Drive Controller, w/ 1MB/second disk transfer rate
- 1 parallel and 2 serial ports
- High Capacity 200Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 387² or Weitek Co-Processor Support

Standard Features Cont.

- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
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Hard Drive Options

- 40MB/25MS
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-InfoWorld, 386/33 Product Review

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- True 25MHz or 33MHz Intel 80386 CPU operating at Zero Wait States
- Direct Map Cache Processor with 84K static RAM standard
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- 1 Parallel and 2 Serial Ports
- 387[™] or Weitek Coprocessor Support

Standard Features Cont.

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- RealTime Clock/Calendar with 5 Year Battery
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- 8 slot Motherboard design
- Medium Footprint Desktop Case with 6 Disk Drive Bays

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- Mini Tower
- Full Size Tower

Hard Drive Options

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- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
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- 640MB/16MS

Video Options

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-Personal Computing, 10 Best Mail Order Companies

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- Norton SI 41.5 (486/25) 51.5 (486/33)
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- 1.2MB or 1.44MB Floppy Drive
- 101 Key Click/Tactile Keyboard
- 1 Parallel and 2 Serial Ports

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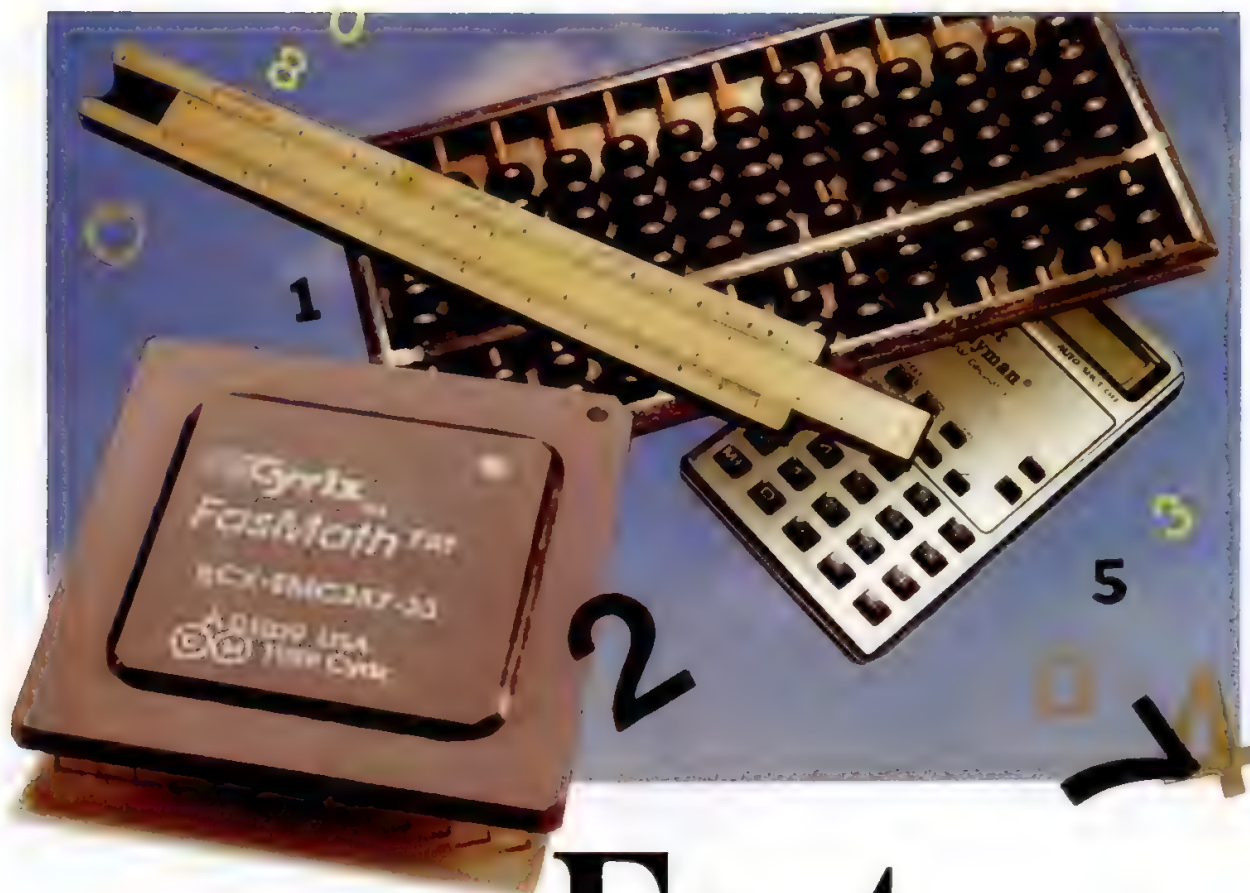
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Math Coprocessors **Fact or Fantasy**

Is a math coprocessor right for you?
PC Magazine takes a close look at the available number-crunching chips to determine the truth behind the legends.

The wizard says "Abracadabra!" and presses a finger inside your PC and you zoom off at double, triple, even quadruple speed. The magic under his finger is a math coprocessor with which—if you believe the claims—you can boost the performance of your PC into the workstation range at a fraction of the cost of upgrading the CPU.

Hocus-pocus or a true technological edge? A math coprocessor is both. It *can* dramatically accelerate calculations—but only certain calculations. While it crunches numbers like a junk yard hydraulic press, most of what your PC is used for, including number-intensive bookkeeping, may not benefit from a math coprocessor.

by Winn L. Rosch

HARDWARE

MATH COPROCESSORS

THE MARKET

The math coprocessor marketplace is quickly becoming crowded. Today you have a choice of many. Three different vendors—Cyrix Corp., Integrated Information Technology, and Intel Corp.—now offer chips that will plug into the 387 coprocessor socket that's standard in nearly all of today's 386-based PCs. And just to confound things further, a fourth manufacturer, Weitek, offers an even more exotic coprocessor purported to deliver greater performance, though with only a limited number of applications. There's even a newly announced software-based math coprocessor emulator called *Soft87* from Multix Inc. (214-239-4989), which is aimed primarily at students. According to Multix, it takes about 3.5 times as long as an equivalent hardware alternative but costs under \$100, so you can run things like *AutoCAD* without the larger cash investment.

The hardware, though, isn't outrageously expensive—relatively speaking—even at the \$994 list price that Intel charges for its 33-MHz 80387. Compare that to the cost of upgrading to a PC with a faster microprocessor and you'll see the market for coprocessors. Moreover, street prices for some chips are lower than half the manufacturer's list. Wall Street sources call the 80387 one of the highest margin—biggest mark up—semiconductors sold.

According to the chip makers, the investment in a math coprocessor will buy you super performance. Benchmark tests written by the coprocessor makers show performance improvements of up to a hundredfold. And these claims, indeed, smack of witchcraft.

THE QUEST FOR THE TRUTH

PC Magazine Labs determined to find the truth. Extensive testing showed a math coprocessor can dramatically improve your PC's performance—but hardly by the extravagant factors claimed by the manufacturers. Further, that performance improvement is highly dependent on the software you run. Under most applications, the benefits of a coprocessor proved elusive. Most programs you're apt to run won't gain any extra speed at all. Even the number-crunching most business people engage in (such as spreadsheet-based accounting) benefits little, if at all, from a math coprocessor. Only computationally-intensive chores like statistics, engineering, and graphics stand much to gain, and the

margin of improvement there hardly rises to the hundredfold claims of the chip manufacturers.

That's not to say that math coproces-

sors are overrated or worthless. If you have a job that can take advantage of one, there's no more cost-effective power-boost you can give your PC. But if you concentrate more on word processing, bookkeeping, or building and sorting



EDITORS' CHOICE

● Four good performers, but no stand-out

Should you buy a math coprocessor? For the majority of *PC Magazine* readers, the answer is no. At just under \$1,000, a math coprocessor is certainly the cheapest way to improve your system's performance...but only if you're using an application that takes advantage of the chip's abilities. Most PC applications don't.

Today, a math coprocessor yields no performance gains in word processors, communications packages, or (for most operations) databases. Although spreadsheet operations are sped up by a coprocessor, the ones you use to calculate your mortgage aren't improved dramatically.

As math coprocessors become a standard component in 80386-based machines, it's likely that more applications will be developed that take advantage of them. But until then, only the most mathematics-intensive applications, such as CAD, derive a significant benefit from a math coprocessor. For those specialized applications, a coprocessor is a must. *AutoCAD*, for instance, won't work without one.

If your applications can tap into the power of a coprocessor, you've got four good choices: Intel's 80387 and the three clones reviewed here—Cyrix's 83D87 and EMC87 and the IIT 3C87. On PC Labs' standard floating-point benchmark test, the coprocessors delivered speeds almost ten times faster than a 33-MHz 80386 without a coprocessor. In our applications-based tests, the performance increase with a coprocessor installed was up to 30 percent, depending on the application and the chip.

The floating-point test results indicated noticeable differences between the coprocessors, with the

Cyrix parts taking the lead. But the applications-based tests showed the chips delivering nearly equal speeds. Since all four chips provide essentially the same level of performance under commercial applications, we haven't awarded an Editors' Choice.

If you want to stick to the name brand and keep your system pure Intel (which, not surprisingly, is Intel's official recommendation), you won't go wrong with the 80387. And you won't lose any sleep worrying about compatibility.

When it comes to pure performance, though, the Cyrix parts beat the 80387. PC Labs' floating-point tests put the Cyrix chips on a par with a 33-MHz 80486. But that performance gain gets lost in most applications. The memory-mapped EMC87 has the potential to yield even better performance than Cyrix's straight 80387 clone. But today's software can't take advantage of it, and it remains to be seen whether the industry will adopt yet another coprocessor standard. Further, there seem to be some BIOS compatibility issues.

One advantage IIT has is that it offers a five-year compatibility warranty. And commercial applications won't run into any difficulties with the slight difference in error-handling of IIT's 3C87, which has been overly publicized by its competitors.

Since there are substantial variations in the street prices of these products, the most cost-effective strategy is simply to shop for the best price. You won't be disappointed.

Finally, if you're buying a new machine and your applications call for a math coprocessor, get an 80486, which has a math coprocessor built in. It'll cost you about the same as a new 80386-plus-coprocessor combination, and it delivers better performance.

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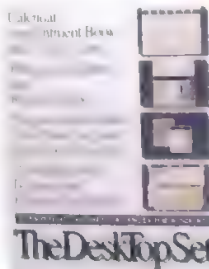
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DeskTop Set

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DeskTop Set\$85



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Ami Professional\$288

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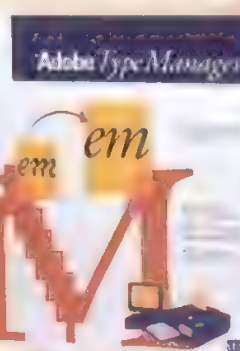
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20 Goudy Old Style	123	58 OCRB OCRB Micr	93	118 Bodoni II	123
21 Sonata	61	59 Helvetica 1	123	122 Cottonwood / Ponderosa	
22 Century Old Style	93	60 Helvetica 2	180	Ironwood / Mesquite /	
23 Franklin Gothic	180	72 Caslon Open Face	61	Juniper	123
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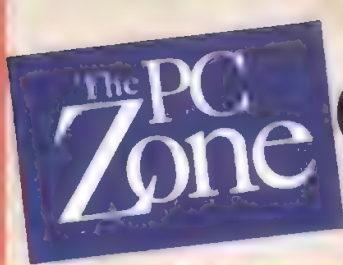
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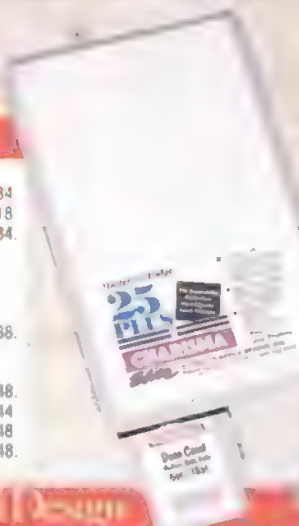
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HARDWARE

MATH COPROCESSORS

databases, you'll be better off saving your shekels for some other strategy.

If your work involves complex mathematics or you want to run an application like *AutoCAD* that requires a coprocessor, you can take your pick of three 80387-compatible chips. According to PC Labs' testing, any will suffice. Notwithstanding inordinate claims and advanced architectures, you'll get roughly the same performance from any chip on most common applications. The power and promise of the more advanced coprocessors simply hasn't yet been tapped by the applications you can run today.

If you really want the fastest possible performance, PC Labs found it best to entirely forgo a math coprocessor and invest in a computer based on Intel's 80486 microprocessor. The 80486 outran every 80386-and-coprocessor combination running at the same clock speed on every application tested.

Of course, upgrading to a new computer is a lot more expensive than simply pushing in a new chip. But coprocessors are essentially plug-and-play products.

You can put one in your PC in 5 minutes and perhaps save half a lifetime in waiting for answers. (Older computers will likewise benefit from the math chips designed for them.)

To give you perspective on what to expect, PC Labs' tests concentrated on math coprocessors compatible with Intel's own 80387. These chips are the most useful because they work with the widest variety of applications. Although the Cyrix 83D87, Cyrix EMC87, and IIT 3C87 are generally considered clones of Intel's 80387, strictly speaking that's not true. Both alternate manufacturers claim design and performance advantages for their products over the 80387. While these chips will handle any program written for the 80387, taking advantage of their proprietary features will require programs written especially for them.

A related product is Weitek's Abacus 3167 chip,

which is covered in the sidebar "What about the Weitek?" Compared with the 80387 compatibles, few programs support the Abacus, and software publishers are still reluctant to expend the effort and cost to add Weitek compatibility to their applications. Also, the Weitek requires a special socket that many PC vendors don't include on their motherboards. In fact, none of the off-the-shelf applications used for testing have any support for the Abacus. Any comparison between it and the 80387 family thus would have been like comparing apples and opals—hardly fair or relevant.

COPROCESSOR FUNDAMENTALS

The concept of a coprocessor is straightforward. A coprocessor is simply something that works in cooperation with your PC's microprocessor. The goal is to provide better performance through specialization and division of labor. The coprocessor takes charge of some particular task that is normally relegated to the general purpose microprocessor, relieving the main chip of some of its load. At the same

BENCHMARK TESTS: MATH COPROCESSORS

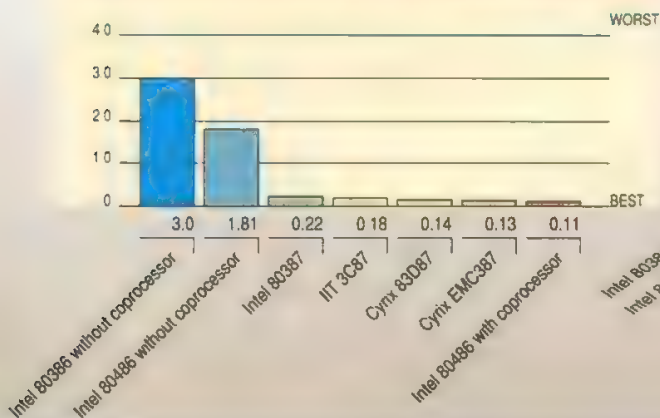
The Cyrix and IIT chips edge out Intel's offering with design and circuitry innovations, but the 80486 remains the overall speed champion.

We ran the math coprocessor tests on a Compaq Systempro with 12MB RAM, 840MB of disk array storage, and a 33-MHz 386 processor board containing 64K of external RAM cache and sockets for 387 and Weitek 3167 coprocessors. We performed 80486 tests by replacing the 386 processor board with a 33-MHz 486 board.

The **Floating-Point Calculation** benchmark test measures coprocessor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. With no coprocessor installed, the same calculations are performed in RAM using a floating-point emulation program.

Floating-Point Calculation

Elapsed Time (seconds)

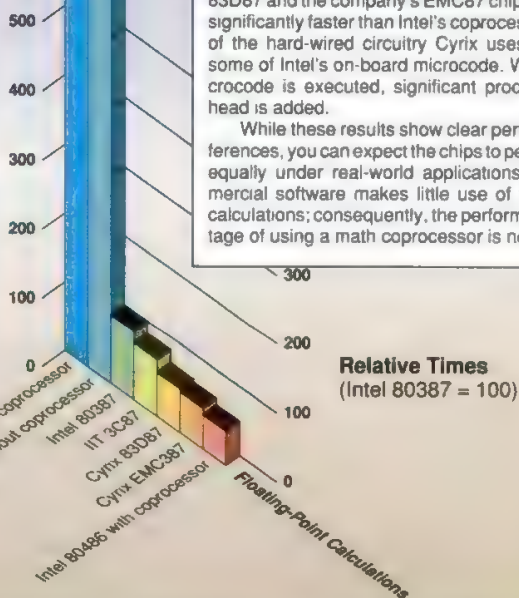


COMPOSITE VIEW: MATH COPROCESSORS

The math coprocessors swept through this benchmark test in less than one-tenth of the time of a 33-MHz 80386 without a coprocessor.

The IIT 3C87 fared slightly better than the Intel 80387 due to its more efficient design. The Cyrix 83D87 and the company's EMC87 chips ran the test significantly faster than Intel's coprocessor because of the hard-wired circuitry Cyrix uses in place of some of Intel's on-board microcode. Whenever microcode is executed, significant processing overhead is added.

While these results show clear performance differences, you can expect the chips to perform almost equally under real-world applications. Most commercial software makes little use of floating-point calculations; consequently, the performance advantage of using a math coprocessor is negated.



HARDWARE

MATH COPROCESSORS

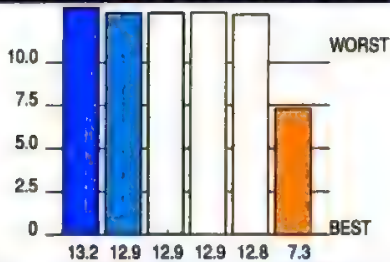


MATH COPROCESSORS: PERFORMANCE TESTS

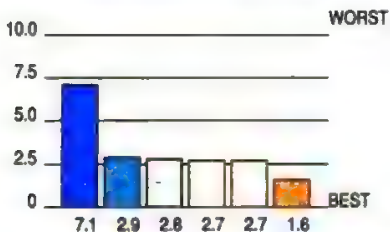
Although PC Magazine Labs' Floating-Point Calculation test showed some clear performance differences, you won't see much of them once you're in a real-world application, as our application-based test results show.

Lotus 1-2-3, Release 2.2

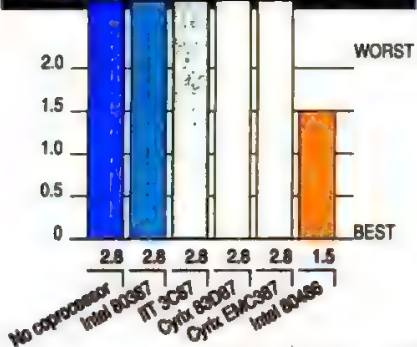
Mathematical Worksheet Recalculation



Financial and Trigonometric Worksheet Recalculation



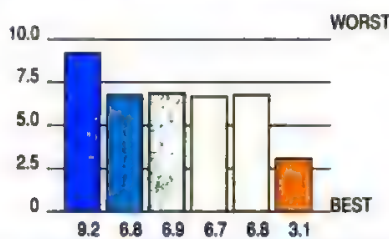
Database Sort



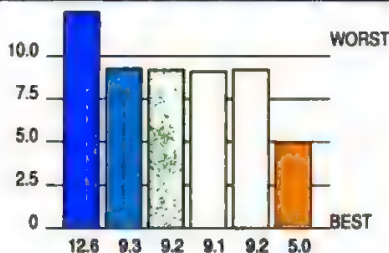
* Elapsed Time (seconds)

Microsoft Excel, Version 2.1D

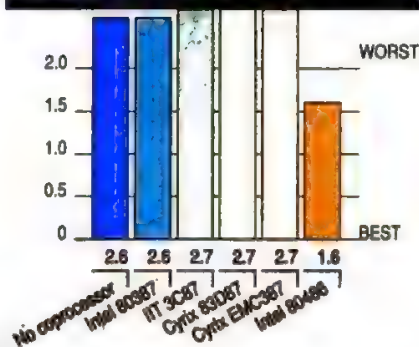
Mathematical Worksheet Recalculation



Financial and Trigonometric Worksheet Recalculation

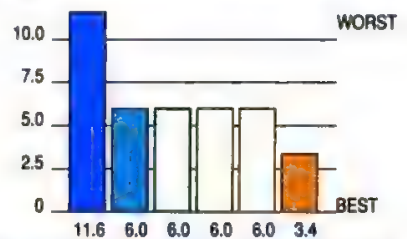


Database Sort

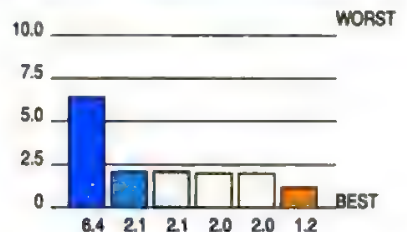


Quattro Pro

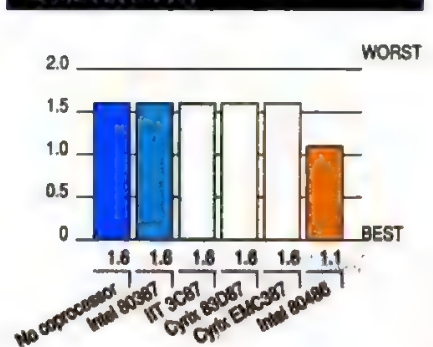
Mathematical Worksheet Recalculation



Financial and Trigonometric Worksheet Recalculation



Database Sort



time, the coprocessor is a specialist, designed to handle one particular task. In sacrificing the need to be all things to all software, it can be trimmed down to the essentials required to perform most efficiently.

Math coprocessors, which are also termed numeric coprocessors or floating-point units (FPUs), are designed to handle all the complex functions that gave you nightmares while daydreaming in high

school: long division, trigonometric functions, roots, and logarithms. These operations yield floating-point numbers, the type that math coprocessors are most adept at handling.

Floating-point describes a way of expressing numbers, not a mathematically defined type of number like integers and rational or real numbers. The essence of a floating-point number is that the decimal point floats between a predefined

number of significant digits rather than being fixed in place the way dollar values always have two decimal places.

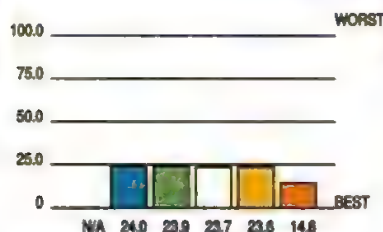
A floating-point number has three parts: a sign, which indicates whether the number is greater or less than zero; a significant—sometimes called a mantissa—which comprises all the digits that are mathematically meaningful; and an exponent, which determines the order of magnitude of the significant, essentially the

HARDWARE

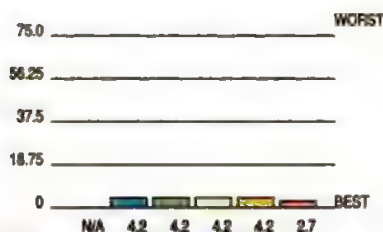
MATH COPROCESSORS

AutoCAD

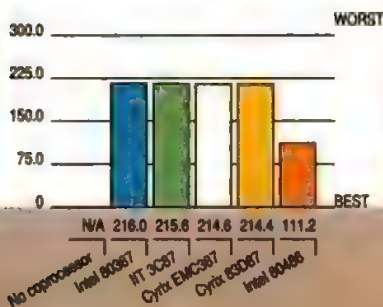
Full-Screen Generation



Entity Select

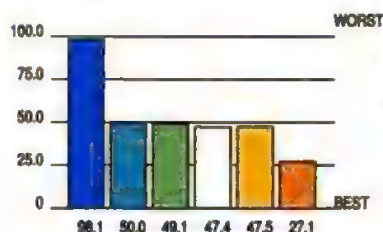


Hidden Line Removal

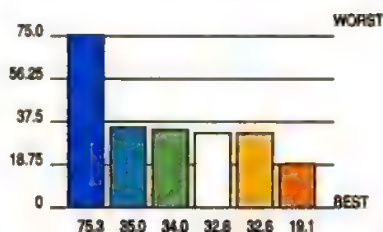


DesignCAD

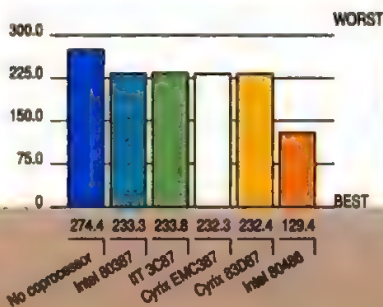
Full-Screen Generation



Entity Select



Hidden Line Removal



The **Mathematical Worksheet Recalculation** test measures the time a program takes to calculate a worksheet containing 1,456 mathematical functions (square root, addition, subtraction, multiplication, division, and @SUM).

The **Financial and Trigonometric Worksheet Recalculation** test measures the time a program takes to calculate a worksheet containing Net Present Value and Net Future Value tables as well as equal-size ranges of trigonometric functions (SIN, COS, TAN, ASIN, ACOS, ATAN).

The **Database Sort** test times the sorting of a 995-record database containing text and values. The sort uses both primary and secondary keys from the ten possible fields; no recalculations are required.

The **Full-Screen Generation** test measures the time it takes to draw a two-dimensional .DXF file (loaded from disk to bypass any image buffering schemes). Timing begins as soon as the first entity appears and ceases when the last entity has been completely drawn and the user has regained control of the PC.

The **Entity Select** test measures the time it takes to erase selected entities in a two-dimensional .DXF file using each CAD package's Group Select procedure. Timing begins upon execution of the delete command and stops when the last entity appears and the user has regained control of the PC.

The **Hidden Line Removal** test measures how long it takes to remove multiple hidden lines from a three-dimensional drawing with several overlapping surfaces. Timing begins upon execution of the Remove Hidden Lines command and ceases when the drawing is completed and the user has regained control of the PC.

N/A—Not applicable: AutoCAD will not run without a math coprocessor.

CONTINUES

location to which the decimal point floats. Think of a floating-point number as one that is represented by scientific notation. But where scientists are apt to deal in base 10—the exponents used in scientific notation are powers of 10—math coprocessors think of floating-point numbers digitally in base 2, all ones and zeros in powers of 2.

In carrying out complex mathematic operations on floating-point numbers, the

coprocessor works much the same way as a general purpose microprocessor. Using digital logic, it processes patterns of bits containing information (the floating-point numbers) under the control of other bit patterns making up instructions. These operations are carried out in registers, special internal memory areas inside the coprocessor.

To make a computation, the math coprocessor first loads one of the numbers

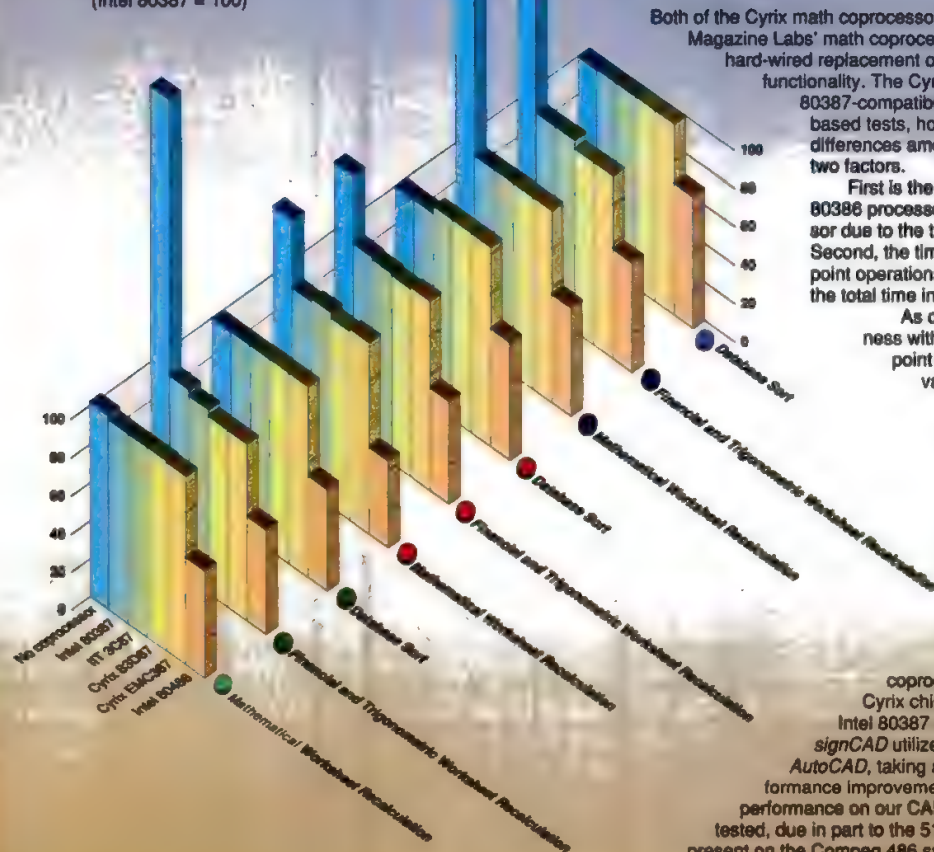
into one of its registers, then loads the second number into another register. Next it reads the program instruction that tells the chip what particular operation it should carry out. The instruction starts another miniature computer program running inside the coprocessor, and that program causes the chip's circuitry to actually calculate the desired answer. The set of programs inside the math coprocessor that respond to the instructions the chip under-

HARDWARE MATH COPROCESSORS



COMPOSITE VIEW: MATH COPROCESSORS

Relative Times
(Intel 80387 = 100)



Both of the Cyrix math coprocessors outperformed the competition in PC Magazine Labs' math coprocessor test suite; this was due in part to their hard-wired replacement of some of the Intel 80387's microcode-based functionality. The Cyrix EMC87 math coprocessor was tested in 80387-compatibility mode. Timings for all the application-based tests, however, showed no distinct performance differences among the products tested, mainly because of two factors.

First is the inherent bottleneck that exists between the 80386 processor and the 80387-compatible math coprocessor due to the timing requirements between the two chips. Second, the time required by these applications' floating-point operations is typically very small when compared with the total time including all I/O overhead.

As our performance graphs show, the effectiveness with which similar applications utilize floating-point operations when performing identical tasks varies. *Lotus 1-2-3*, Release 2.2, utilized the math coprocessor least, showing the smallest overall increase in performance on our spreadsheet tests.

Borland's *Quattro Pro*, Version 1.1, showed the most noticeable coprocessor results of the three spreadsheet packages tested. The results among the Database Sort test showed no improvement with a math coprocessor present because sorting is a memory-swapping function and doesn't involve floating-point operations.

There were no standouts among the coprocessors when tested with *AutoCAD*, but the Cyrix chips showed a slight improvement over the Intel 80387 in *DesignCAD*. This indicates that *DesignCAD* utilizes floating-point code more efficiently than *AutoCAD*, taking advantage of the available coprocessor performance improvement. The Intel 80486 provided excellent performance on our CAD tests compared with the 386 coprocessors tested, due in part to the 512K of external processor RAM cache present on the Compaq 486 system board.

stands are called its "microcode."

Once a result has been calculated, getting the answer out of the coprocessor requires the execution of another instruction. Alternatively, the next instruction can make the coprocessor carry out another operation on the results of the first.

General purpose microprocessors operate exactly the same way—they load values, read instructions, and execute microcode. The coprocessor earns its speed advantage in handling floating-point numbers because its command set includes high-level mathematic operations. It also has more internal circuitry devoted to carrying out those instructions. For example, a general-purpose microprocessor can compute an irrational root, but it might have to execute a loop of simple instructions hundreds of times to come up with the answer, performing hundreds of iterations of integer math.

The coprocessor solves the same problem with a single instruction.

CHIP HISTORY

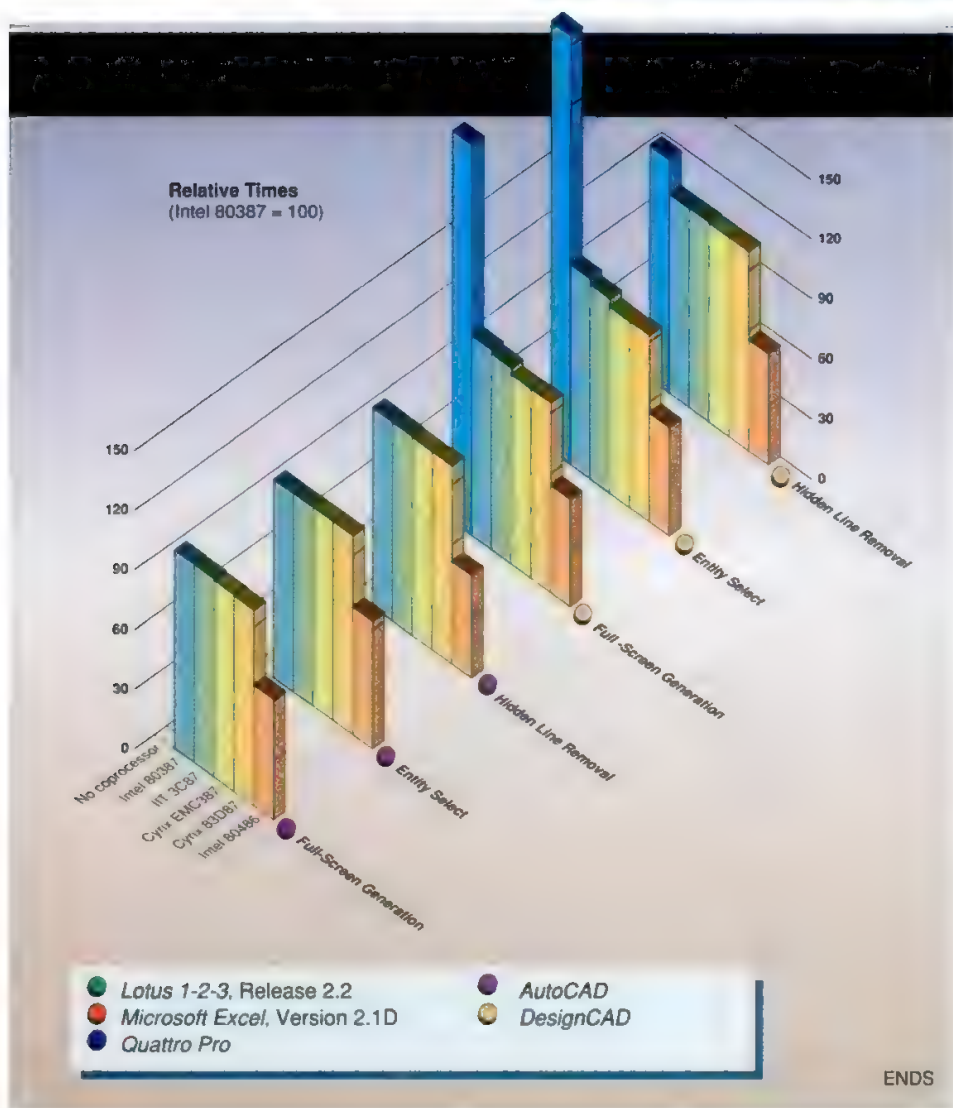
In the mid-1970s there were no math coprocessors as we know them today. Computers at that time were all mainframes and minicomputers. They all did floating-point operations and, oddly enough, they all came up with different answers. Not that they added 2 and 2 and deduced different results. Rather, when they calculated irrational numbers and rounded them, the last few decimal places varied depending on what make and model of computer did the calculating. The problem was that irrational numbers have an infinite number of decimal places and computer memories are finite. Irrational answers can only be approximations, and

different computers used various methods of approximating and rounding irrational numbers.

Scientists weren't thrilled to have the results of their calculations vary with the hardware on which they computed, so the Institute of Electrical and Electronics Engineers (IEEE) formed an industry committee to develop standards for floating-point calculations. At the same time, Intel Corp. was developing a successor to its 8080 and 8085 microprocessors and decided it should develop a hardware implementation of the IEEE standard as part of that microprocessor program. The microprocessor itself would become the 8086, the immediate predecessor of the 8088 that served as the foundation for the IBM PC. Of course, no one considered personal computers to be a high-volume product at the time, but Intel foresaw

HARDWARE

MATH COPROCESSORS



1980—the 8087 math coprocessor.

The 8087 lagged the microprocessor it was to complement for a very good reason: It was hard to design. According to Intel, at the time of its introduction the 8087 was the most complex large-scale integrated circuit ever produced.

Even so, the 8087 could not perform its math operations by itself. Instead, it must work in conjunction with the 8086. The 8086 and 8087 function as a single processor, one that understands 68 more machine language instructions for floating-point operations than does the 8086.

The 8087 can also operate in conjunction with the other microprocessors derived from the 8086. These include the 8088 used in PCs and XTs as well as the 80186 and 80188.

The 8087 fits into a 40-pin DIP socket providing the chip with the same addressing and data handling abilities of the microprocessors it was to match. While it can accept data from a 16-bit bus, it'll also work without modification with the 8088's 8-bit bus. The 8087 ordinarily shares the same clock frequency with its microprocessor cohort and operates at the same speed.

Intel still offers 8087 chips with three models rated at different speeds. The 5-MHz chip, which matches the IBM PC and XT that operate at 4.77 MHz costs \$142. An 8-MHz version is available for \$205, and a 10-MHz model for \$270.

THE 80287'S BETTER BUS CONTROL

In the 8087's original design, Intel had the foresight to divide the chip's circuitry into two functional elements: a bus interface unit and a floating-point unit. The former links the chip to the rest of the system in which it is installed (the microprocessor in particular) and the latter performs the actual calculations. As a result, upgrading the math abilities of the 8087 to other environments only requires modifying the bus interface, rather than redesigning the entire chip.

The 80287, introduced in 1985, takes advantage of that strategy. Essentially, this chip is the floating-point section of the 8087 coupled with new interface logic to match the Intel's 80286 microprocessor chip.

As with the 8087, the bus control logic of the 80287 is designed to link to an 80826 and rely on the microprocessor host for system support. The coprocessor chip doesn't even have access to the computer's address lines, so all memory-

advanced floating-point capabilities as being useful in robotic and numeric control applications.

At the time the 8086 microprocessor was being developed, before its introduction in 1978, creating an integrated circuit was a much more exotic process than it is today. The technology was still primitive, and the size and number of components that could be grown and etched onto a silicon wafer limited the complexity of possible (or at least affordable) integrated circuits. At the time, microprocessors were the most complex circuits ever designed.

The larger the chip, the more likely it is to contain some defect making it unusable. On the other hand, technology constrained how small the details of the chip design could be. If layouts were too small, they were also more likely to suffer manufacturing defects, again making the chip

unusable. For example, the smallest possible details in the 8086 microprocessor measured five to ten microns across. Today chips are made with details as fine as one micron.

Together, these two limits conspired to put an effective lid on circuit complexity. The 8086 by itself pressed hard against those limits. Making the chip even more complex was out of the question.

Other chips made do without the need for dedicated floating-point units. There were no coprocessors for the (at that time) popular 8080 and Z80 chips. Most applications didn't need a floating-point processor that followed the evolving IEEE standard. Consequently, advanced math functions were not included in the 8086 but were instead being relegated to a separate element, which eventually was produced as a commercial product in

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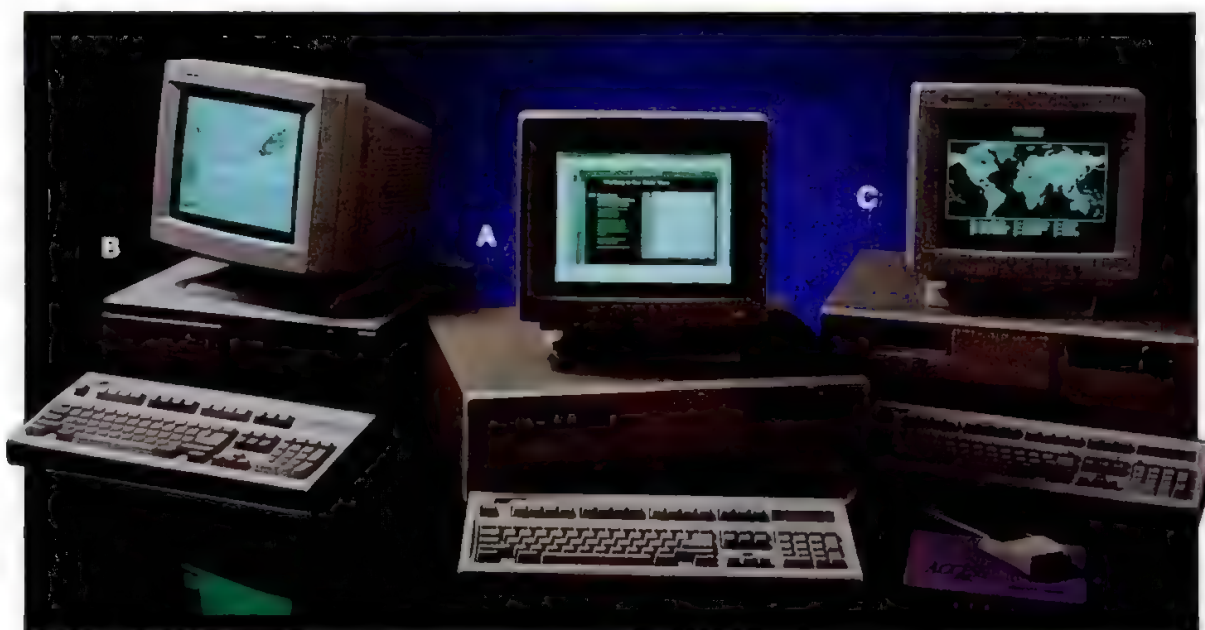
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13.3"D-Free Ext. 5.25" FDD
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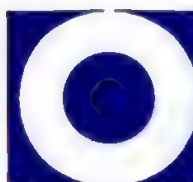
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related operations are handled by the main microprocessor. This design allows the 80287 to deal with both the real and protected modes of the 80286, and enables it to address the microprocessor's full 16MB range. The 8087 operates only in real mode.

As with the 8087, the 80287 is packaged in a 40-pin DIP socket but is not pin-for-pin compatible with the 8087. For example, address lines are not brought to

are the 5- and 6-MHz versions of the 80287.

Because the 80287 is based primarily on the 8087 floating-point circuitry, the chip is almost completely backwards-compatible with the 8087 and will execute most of the same software—though not all, because the floating-point unit is not a gate-for-gate copy of the 8087 but

floating-point unit.

The new floating-point unit design did more than implement the new IEEE standard. It was also faster than the old 8087/80287 by roughly a factor of five. After its introduction in 1987 as part of the 80387, the new floating-point unit became the foundation of all later Intel math coprocessors. It also serves as the foundation of the 80387SX and the newest revisions of the 80287: the 80287XL and 80287XTL. (The 80387SX is essentially the same chip as the 80387, but designed to work with the 80386SX's 16-bit bus instead of a full 32-bit data bus.) Much of its design is also carried over into the 80486 microprocessor's floating-point section.

The 80387 promises a similar degree of backwards compatibility with the 80287 as the 80287 does with the 8087. The primary differences appear again in error handling, mostly because of changes in the IEEE standard. These differences are easily managed by properly written software. On some problems the 80387 or 80387SX may in fact deliver slightly different answers than an 80287 would—not to the extent of adding 2 and 2 and getting 22 but deriving transcendental functions that may differ in the far-right decimal place. Not that either microprocessor is wrong; the 80387 and 80387SX just conforms better to the current IEEE standard.

Another change Intel made in updating the floating-point units of the 80387 was endowing the chip with a greater range of transcendental functions, including sine, cosine, tangent, arctangent, and logarithmic functions. As a result, while the 80387 and 80387SX should be able to run all programs written for the 80287, the reverse is not necessarily true. Programs that take advantage of all the power of the 80387 or 80387SX may not run on the lesser chip. In general, however, code meant for the 8087 and 80287 will run on either.

Although it can operate asynchronously, an 80387 functions at the same speed as the 80386 it's installed with. There are 80387 coprocessors available in all the speed variations of the 80386, all the way to 33 MHz.

The 80387 even looks like an 80386, only smaller. Its square 68-pin PGA (Pin Grid Array) case has the same slate-like appearance as the microprocessor. The speed rating of the chip is given in megahertz following the part number. Thus, a 80387-20 is rated to operate at 20 MHz.

When Intel began to design a coprocessor to match the 80386, it chose to develop both a new bus-interface unit and a new floating-point unit. The new floating point unit was faster than the old 8087/80287 by roughly a factor of five.

the 80287 socket. Instead all addressing is handled by the 80286.

Unlike the 8087, the 80287 is designed to operate asynchronously. That is, the coprocessor does not necessarily operate at the same speed as its host microprocessor. The two chips, microprocessor and coprocessor, know how to adjust their operations, waiting as necessary, to match their data transfer cycles.

Ordinarily, the 80287 is connected with the same oscillator that runs the rest of a PC. However, an internal divider slows down the clock frequency of the 80287 to one-third its original speed before it reaches the floating-point circuitry. Hence, an 80287 operates at one-third the clock speed presented to it.

In most 80286-based systems, the clock that runs the microprocessor is divided in half before being connected to the 80286. Typically, the original double-speed clock is connected to the 80287 so that the coprocessor effectively operates at two-thirds the microprocessor speed. For example, in an 8-MHz IBM AT, the 80287 coprocessor runs at 5.33 MHz.

Some systems give the 80287 a dedicated clock of its own, allowing the engineer designing the system to operate at whatever speed he wants. Using a dedicated clock can boost the 80287's data throughput substantially.

While Intel at one time offered four different speeds of 80287, the company's current line has been trimmed to two. An 8-MHz version is priced at \$326, and a 10-MHz model runs at \$374. Discontinued

was improved somewhat in the upgrade. Differences in the two chips show up primarily in the way they handle errors. Software can compensate for the differences in the chips, so a well-written program will run on either coprocessor.

The Intel bus-control logic design of the 80287 that makes the coprocessor rely on its microprocessor host for addressing information means the 80287 is not limited by the 16MB memory-handling abilities of the 80286. The versatile design allows the 80287 to operate with 80386 microprocessors as well, and for two years it was the company's official coprocessor for the 80386.

But the 80286 had shortcomings in the 80386 environment. The 80286 was designed with a 16-bit interface, while the 80386 was capable of 32-bit operations. Also, the 80287 had been left behind by the evolving IEEE floating-point standard. Only after the 80287 was in production was the IEEE floating-point standard put into its final form—now known as ANSI/IEEE 754-1985. In some subtle ways, the 80287 and the finalized standard were at variance. Consequently, the 80287 is not the ideal math coprocessor, particularly for 80386-based PCs. Nevertheless, a slow 80287 is still faster on floating-point operations than an 80386 alone.

THE 80387

When Intel began to design a coprocessor to match the 80386, it chose to develop both a new bus-interface unit and a new

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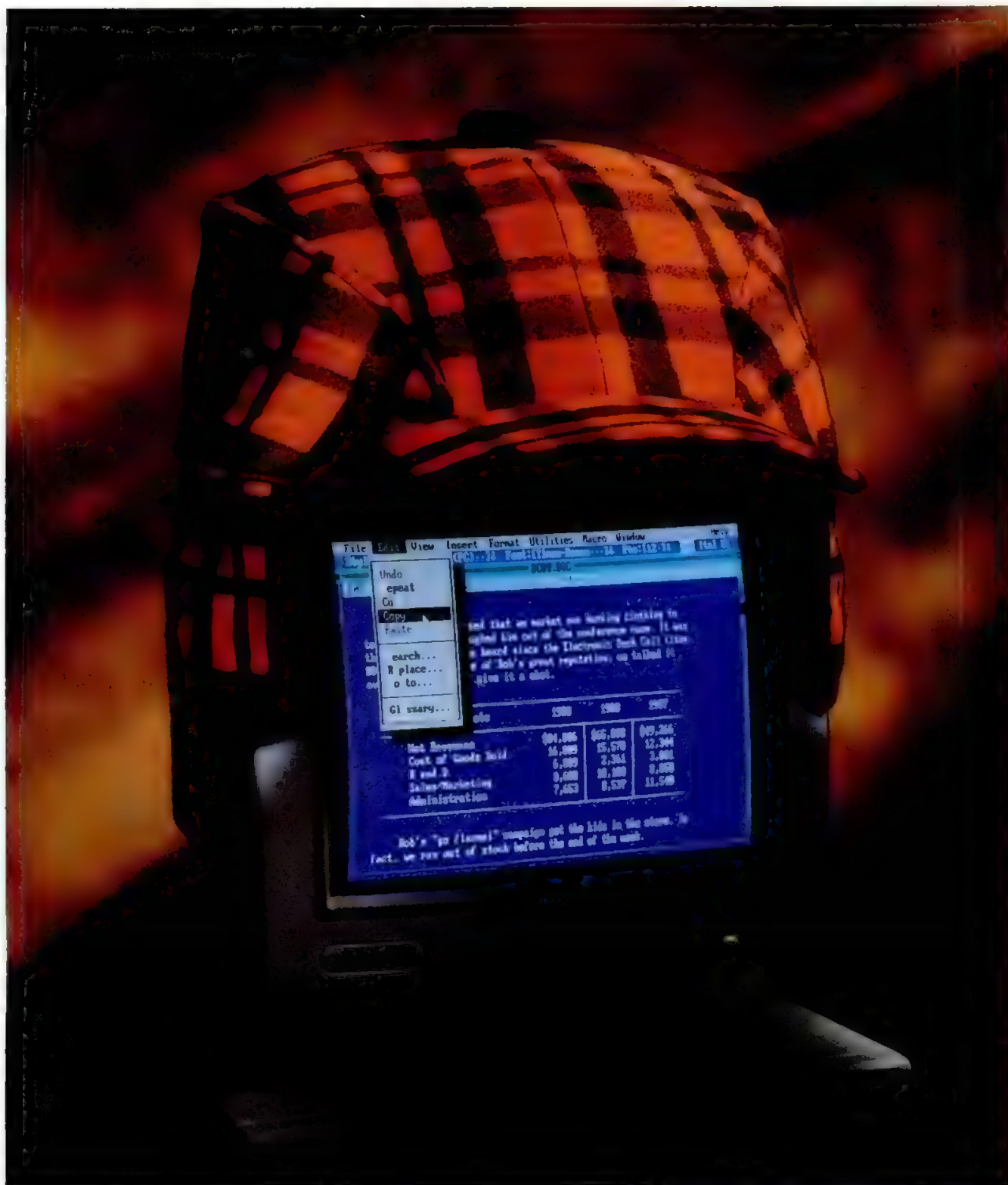
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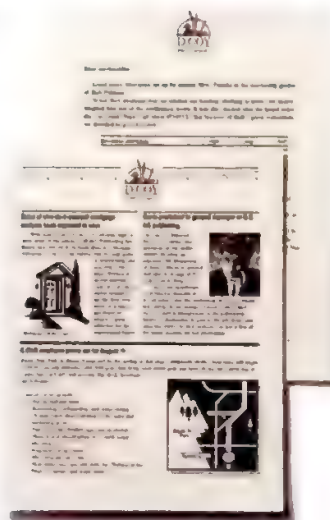
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THE 80387: A Programmer's Perspective

by Richard Hale Shaw

To programmers, the 80387 is more than an add-on peripheral: It's an integral part of an 80386 system. Dedicated to handling real number arithmetic, the 80387 can perform numeric calculations more quickly and easily than the 80386. But just plugging a 80387 into your PC doesn't automatically let software run faster when performing floating-point math. To tap the power of a 80387, a program must ensure that numeric calculations will be performed on the coprocessor.

CONCURRENT EXECUTION

The 80386 creates the illusion that it is actually performing the floating-point operations: When the 80386 encounters an 80387 instruction in a program, it waits until the 80387 is idle and then passes the instruction to the coprocessor. Once the 80387 begins execution, the 80386 moves on to the next instruction; it doesn't wait for the coprocessor to finish. This allows the 80386 to continue running while the 80387 is executing a complex instruction.

By having the 80386 perform tasks concurrently with the 80387, a programmer can optimize an application's performance—or get into trouble. What if the 80386 attempts to use the output of an 80387 operation before the latter has finished? To prevent this, a programmer can use the 80387 **FWAIT** instruction to synchronize the two processors. This forces the 80386 to wait until the 80387 has completed its task.

387 DATA TYPES

While the 80387 only uses floating-point numbers internally, it is capable of recognizing and accessing seven data types in a program. All seven reserve the first bit as a sign bit. Three of these data types, in 16-, 32- and 64-bit sizes, are binary integers. They're identical to those used in conventional 8088 assembly language programming and can store values as high as 9E18.

A fourth data type uses a binary coded decimal (BCD) format that packs two decimal integers into each group of 4 bits; thus, it can pack a number 18 digits long into its 72 bits.

Finally, the 80387 supports three real number formats in 32, 64 and 80 bits, and

stores values as high as 3.37E4932. On-board the 80387, all numbers are automatically converted to the last of these, a format known as "temporary real."

These allow a programmer considerable flexibility, since different applications may require diverse data formats. It does mean a little more work for the programmer, who must be familiar with different versions of the same 80387 instruction. For instance, **FADD** is used to add real numbers, but **FIADD** adds integers. Fortunately, an assembler will detect data typing errors.

387 ARCHITECTURE

Just as the 80386 offers registers, flags, and status bits to load and manipulate addresses and values, so does the 80387. The 80387 contains eight 80-bit registers that correspond to the 80-bit extended precision data format. While these can be used as individual registers, they are designed to be used as a stack. Thus, many 80387 instructions have the side effect of modifying the top of the stack indicator, and most implicitly place the results of an operation in the top register of the stack. In addition, the 80387 Status Register tells whether the 80387 is idle, which data register corresponds to the top of the stack, and whether an exception (error) occurred. A Control Register contains fields to control precision, rounding, and interrupts.

PROGRAMMING THE 80387

Programmers can include 80387 instructions in their 80386 assembly language programs. However, they must use the **.387** directive for the assembler to accept 80387 instructions and allow the use of scientific notation (such as 1.23E5) when specifying numbers. This directive also converts constants to real number format.

At the binary level, all 80387 instructions begin with the same five bits, 11011, which instruct the 80386 to pass them to the coprocessor. Accordingly, all 80387 mnemonics (and no 80386 mnemonics) begin with "F," such as **FADD** instead of **ADD**. Suppose you wanted to use the 80387 to calculate the area of a circle, which is obtained by multiplying pi by the square of the circle's radius. With two variables, "radius" and "result," the code might

look like this:

INIT (initialize the 80387)

FLD RADIUS (load radius and put it on top of stack)

FMUL RADIUS (square it and put result on top of stack)

FLDPI (Load pi into new top of stack)

FMUL (multiply pi times square of radius)

FSTP RESULT (retrieve top of stack value into "result")

FWAIT (synchronize with 80386)

The **INIT** instruction initializes and resets the 80387; you must use it the first time the 80387 is used in a program (and, putting another one at the end is also a good idea). After initialization, the program uses **FLD** to load "radius" into the top register of the stack. Next, the radius value is squared by multiplying it by itself, and the product is placed in the top of the stack register. **FLDPI** moves the stack down one register and loads the value of pi into the new top of the stack. Next, **FMUL** multiplies the two adjacent registers and places the product in the top of the stack register. Then **FSTP** moves that value into the variable "result." Finally, **FWAIT** causes the 80386 to pause until the 80387 has finished the **FSTP** instruction. Considering that "radius," "result," and pi are all real numbers, these seven lines of code illustrate some of the true power of the 80387.

The 80387 offers an instruction set that supports a host of mathematical operations, including commands to load logarithms and pi (shown above) as well as calculate a square root. Other instructions let you save and restore the contents of an 80387 to a memory location. And, a few 80387 instructions are exclusive, and cannot be found in the instruction set of the 80287—**FSINE** (to calculate the sine of an angle), **FCOS** (to calculate a cosine), and **FSINCOS** (to calculate both at once).

For programmers, detecting an 80387 is not difficult. After it's been reset, the 80386 automatically programs a single bit in its Control Register to 0. If set to 1, this bit designates the presence of an 80387, otherwise the bit is 0. Unlike older systems, contemporary 80386 systems don't require changes to the system switches after you install a coprocessor; the system automatically detects its presence. ■

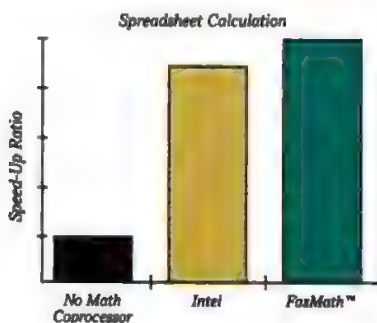
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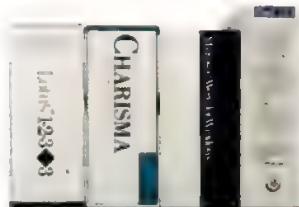
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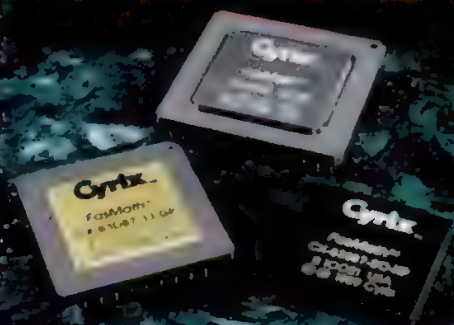
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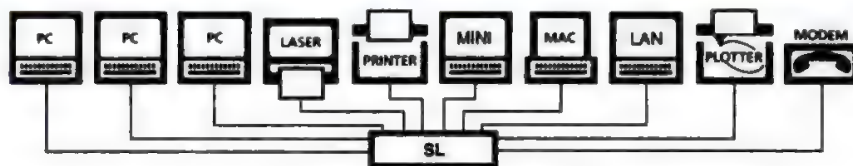
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The 80387 design has not been static. When it became necessary to boost the 80387 to 33 MHz, further design improvements were needed. Intel switched from N-channel Metal Oxide Semiconductor (NMOS) technology to Complementary Metal Oxide Semiconductor (CMOS) and used new manufacturing processes that allowed details as fine as one micron to be etched in the chip's silicon. (Older 80387s were limited to 1.5 micron details.) These improvements, along with some tinkering in the floating-point unit itself, yielded a performance improvement of about 20 percent.

The 33-MHz 80387, introduced in April 1989 and now priced at \$994, incorporated all these features. On October 1, 1990, the 16-, 20-, and 25-MHz versions of the 80387 were upgraded to the new technology. (You can distinguish old technology 80387s from new-technology chips by the numeric code under the part number. Old 80387s always begin this line of ten numbers with the letter S. New-technology chips lack the S. Chips rated at 16 MHz are list priced at \$570, 20-MHz versions go for \$647, and 25-MHz models run \$814.)

The 80387SX math coprocessor complement for the 80386SX microprocessor was introduced in January 1990, using the new technology as well. Two versions of the 80387SX are currently available: a 16-MHz chip for \$506, and a 20-MHz version for \$550.

In January 1990, Intel also adapted this new technology to the 80287, producing the 287XL and 287XTL. Faster and less power-hungry than the NMOS versions, the new chips are priced to make the old obsolete—\$326 for either one—although the NMOS chips are still available.

Either CMOS 80287 will operate at speeds up to 10 MHz. The 287XTL is a low-power design aimed at laptop computers. It fits a PLCC (Plastic Leadless Chip Carrier) socket, while the XL is compatible with the 40-pin DIP sockets used by earlier 80287 implementations.

Note that no Intel 80287 is rated to operate faster than that 10 MHz. However, IIT introduced its own 80287 compatible that operates at speeds up to 20 MHz in computers that can supply the necessary clock signal to their coprocessor sockets. (Advanced Micro Devices and Harris Semiconductors are reportedly also working on higher-speed 80287-compatible chips.) The 20-MHz IIT 2C87 is priced at \$419. IIT also offers a lower-

WHAT ABOUT THE WEITEK?

by Winn L. Rosch

What about the Weitek? Every PC having the temerity to call itself high performance has an extra-large coprocessor socket awaiting a Weitek Abacus coprocessor. For the last three years, the Weitek math coprocessor has been touted as the Ferrari of system accelerators. Why didn't PC Labs compare an Abacus 3167 to the 387 compatibles?

For one very good reason: The applications used for testing didn't support Weitek's chips. In fact, even according to Weitek, relatively few commercial programs have built-in support for the company's Abacus series—about 38 applications at the time of this writing. Most of those are specialized scientific packages, high-end CAD programs, or developmental software—not exactly in the same product mainstream as *Microsoft Excel*, *Quattro Pro*, and *Lotus 1-2-3*.

If you know the history of Weitek, that situation may be unexpected. The company was formed in 1981 and by 1985 was producing floating-point coprocessors for a variety of workstations, including those based on the Motorola 68020 and Sun's SPARC microprocessors. Around that time, Intel contracted Weitek to develop a coprocessor for the 386. According to Weitek, the in-house Intel 387 program was behind schedule and Weitek developed its product in parallel with the 387 team.

Those efforts led to the Weitek 1167, the first of the Abacus line. It was a small circuit board that combined two of the company's coprocessor elements used in 68020 computers along with interface logic to match the 386. In April 1988, Weitek introduced the 3167, a single chip equivalent to the 1167, used to enhance Intel 386 chips. In November 1989, the 4167 was introduced, a math coprocessor designed to enhance the Intel 486 that maintained compatibility with the Abacus 3167.

Currently three models of the 3167 are available: a 20-MHz version priced at \$495, a 25-MHz version priced at \$795, and a 33-MHz version priced at \$995. Two versions of the 4167 are available: The 25-MHz model is priced at \$995, and the 33-MHz goes for \$1,295.

The Abacus chips won't work on software that supports the 387 because the Weitek coprocessors are all memory-mapped and built around an architecture entirely different from that of the 387 family. Unless the software you have explicitly supports an Abacus, you won't see any speed improvement using one.

Just to be sure that we weren't missing anything, though, PC Labs did run a head-to-head comparison of the Weitek 3167 with the Cyrix 83D87, IIT 3C87, and Intel 387 using one of the applications that does support both I/O-mapped and memory-mapped coprocessors: *VersaCAD-386*.

On the three scenarios tested—loading and screen generation and mass entity deletion—the Weitek gave no significant performance improvement over the other chips. The results were so disappointing, we called Weitek to check whether we did anything wrong.

According to Weitek, no appreciable difference in performance between the Abacus and 387 chips will be seen in *VersaCAD-386* except when doing hidden-line removal on complex 3-D images. No significant gain can be expected for 2-D images. Whenever substantial I/O overhead is present in the software, the effect of using the Abacus chip will be reduced to the level of the 387. Of course, such overhead is present in nearly all commercial applications.

To come up with the impressive figures Weitek uses in its promotional materials, the company ran its tests using a large RAM disk to minimize disk overhead and a high-end graphics coprocessor to speed up video displays. If you opt for such all-out performance-enhancement strategy, the Weitek Abacus chips may prove worthwhile. Just don't count on fantastic speeds when your applications are constrained by lots of I/O overhead. ■

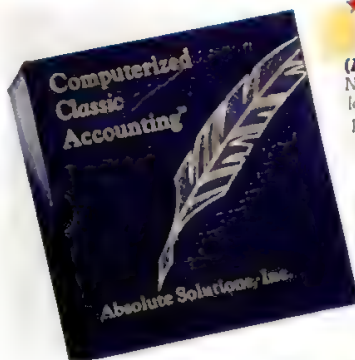
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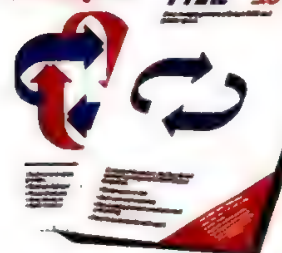
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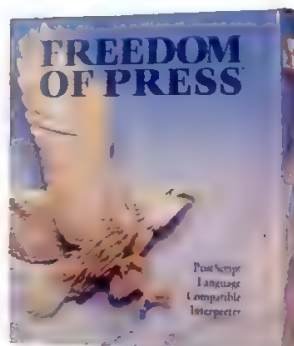
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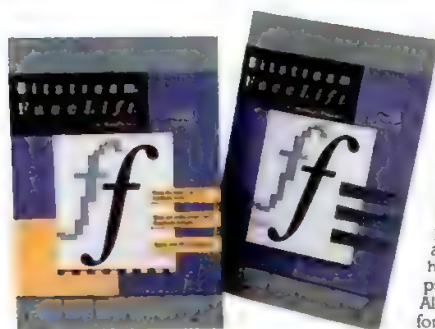
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(Timeslips Corp.) Simplify the tedious task of billing for busy professional firms. A timer module operates in pop-up window, accessible within any application. Accommodates up to 3400 clients, with as many as 250 professionals. Features time and expense tracking, a choice of customizable bill formats, customer management reports and complete account receivable tracking. \$169.

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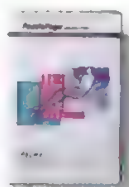
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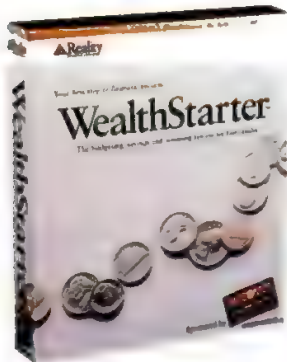
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Chronologic Corp.

Instant Recall 64.

Chronos

Who What When 2.0 179.

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Compuserve Info Service 21.

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Crosstalk Communications

Crosstalk Communicator 65.

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Crosstalk XVI 3.71 104.

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(Visionary Software) A unique and beautiful system for managing change. Supports intuitive decisions and better relationships, while reducing stress and worry. Based on Jungian psychology and Ching. Timeless wisdom was never so entertaining! \$36.



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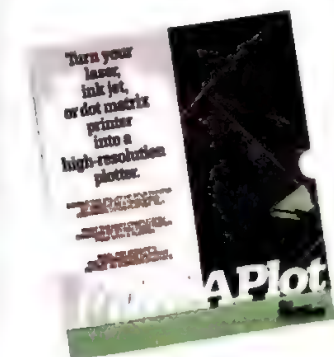


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(Software Products International) Run your business more efficiently with Open Access III, a relational database. Features a spreadsheet module, word processing program, communications and desktop tools. Fully menu-driven, point and shoot forms editor, and much more. \$425.



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★ Ultrascript PC 2.1	119.
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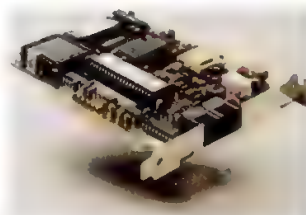
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DESQview 2.3	69.
DESQview 386 5.1	119.
QEMM 50/60 5.1	59.
★ QEMM 386 5.1	55.
QRAM	45.
Reality Technologies	
Wealthbuilder 1.1 (by MoneyMag.)	145.
WealthStarter	49.
Reference Software	
Grammatik IV 1.0	49.
★ Grammatik Windows	49.
Revolution Software	
Cruise Control	45.
VGA Dimmer	25.
Rightsoft	
Rightwriter 4.0	59.
Rupp Corporation	
FastLynx 1.01	119.
Sarna	
★ Ami 1.2	125.
★ Ami Professional 1.2	305.
Sitka	
Inbox Plus Mac/PC 100-User	620.
TOPS 3.0 Network Bundle DOS	189.
TOPS FlashCard	148.
Softlogic Solutions	
Cubit 3.0	45.
Disk Optimizer 4.05	39.
Software Carousel 3.01	55.
Softview	
★ If-X Business Expense Reports	49.
Software Directions	
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PrintQ LAN	259.
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Syblz	
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Touchstone	
Check It! 2.1	85.
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Laplink III	89.
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Turbo C Prof. ++	170.
Turbo Pascal 5.5	98.
Clarion Software	
Personal Dev. System	47.
Professional Dev. System 2.1	499.
Lattice, Inc.	
Lattice C 6.0	155.
Microsoft	
C Compiler 6.0	319.
Macro Assembler 5.1	108.
Quickbasic 4.5	69.
QuickC 2.5	69.
Nantuckel	
Clipper 5.0	499.
Solution Systems	
Brief 3.0 for DOS/OS/2	179/159.
Spinnaker Software	
★ Spinnaker Plus	285.
Symantec	
Norton Editor 2.0	56.

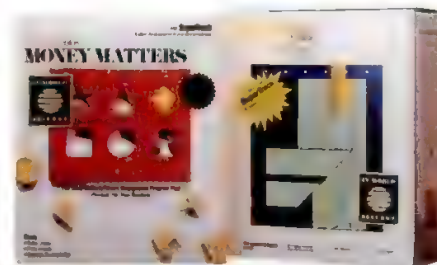
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speed version of the 2C87. The 8-MHz chip lists for \$293, the 10-MHz model will run you \$319, and the 12-MHz 2C87 goes for \$339.

COPROCESSOR ARCHITECTURES

No matter the part number or speed, all Intel math coprocessors share the same architectural elements. The Intel design makes a math coprocessor a separate piece of hardware that's logically integral to the microprocessor. The only thing changed when you add a coprocessor is that the microprocessor understands a wider repertoire of commands. These commands elicit answers to mathematic questions at greater speed.

The Intel approach represents one of two methods currently used for connecting a coprocessor inside PCs. These two types include (1) those chips that link to the main chip via a direct connection of input and output ports through which they send and receive data and instructions, and (2) those that instead use a memory range to accomplish the same thing. In this article, the first type, which includes the entire Intel coprocessor family, will be termed "I/O-mapped coprocessors." The second type we'll call "memory-mapped coprocessors," and these include the Weitek line, which pioneered this connection technique. All Intel-compatible math coprocessors, including the Cyrix 83D87 and IIT 3C87, are I/O-mapped.

A brand new coprocessing contender, the Cyrix EMC87, has characteristics of both types of coprocessor. This Cyrix chip works as an I/O-mapped chip for compatibility with software written for the Intel, yet can also accelerate to memory-mapped speed with future applications written to take advantage of its special capabilities.

INTEL'S I/O-MAPPED ARCHITECTURE

In the Intel design, both the microprocessor and the coprocessor are connected to the data lines that carry information—program instructions as well as data—inside your PC. Normally, the microprocessor carries out all instructions in most computer programs. Certain instructions are recognized by the math coprocessor as its own, however, and it can carry them out directly.

In a way, the I/O-mapped coprocessor is like a leech, a parasite that cannot live without the microprocessor. Only the microprocessor has circuitry to control your PC's address lines to find informa-

tion. Consequently, proper operation of the coprocessor requires careful coordination of its work with that of the main chip. The two chips' efforts are kept together through a direct hardware link (wires connecting the two chips) electrically controlled through input/output ports. These ports are internal on the two chips and, unlike the I/O ports used by your PC's peripherals, cannot be accessed directly by you.

Both the microprocessor and the coprocessor have their own registers (in which all calculations take place) and internal control circuitry. As a result, the two chips can operate somewhat independently. That is, while your math coprocessor is wrestling with a particularly difficult problem, the microproces-

The eight 80-bit registers also differ from those in a microprocessor in the way they're addressed. Commands for individual microprocessor registers are directly routed to the appropriate register as if sent by a switchboard. Coprocessor registers are arranged in a stack, sort of an elevator system. Values are pushed onto the stack, and with each new number the old one goes down one level.

In theory, this I/O-mapped design could add a degree of parallel processing to your PC. In reality, it often doesn't. Most programs send the math chip scurrying off in search of an answer and leave the microprocessor to wait until the results are found. On the other hand, Borland's *Quattro Pro*, for instance, takes advantage of this parallel-processing capability. By carefully hand-coding assembly language routines, Borland achieved a high degree

By hand-coding assembly language routines, Borland achieved a high degree of parallel processing when a coprocessor is present. That's why *Quattro Pro* showed a greater performance increase with a coprocessor than other spreadsheets during testing.

sor could do something else.

The Intel-style coprocessors work with 80-bit registers. Eighty-bit registers are exactly the right size to accommodate 64 bits of significant data with 15 bits left-over to hold an exponent value and one extra bit for the number's sign.

The registers in Intel coprocessors aren't limited to this single data format, however. They can calculate on 32-, 64-, or 80-bit floating-point numbers, 32- or 64-bit integers, and 18-digit binary-coded decimal (BCD) numbers. (Binary-coded decimal numbers simply use a specific 4-bit digital code to represent each of the decimal digits between zero and nine.)

Each Intel chip has eight of these 80-bit registers in which to perform its calculations. Instructions in your programs tell the math chip what format of numbers to work on and how. The only real difference is the way in which the math chip delivers its results to the microprocessor when it's done. All calculations are carried out using the full 80 bits of the chip's registers, unlike Intel microprocessors, which can independently manipulate registers in byte-wide pieces.

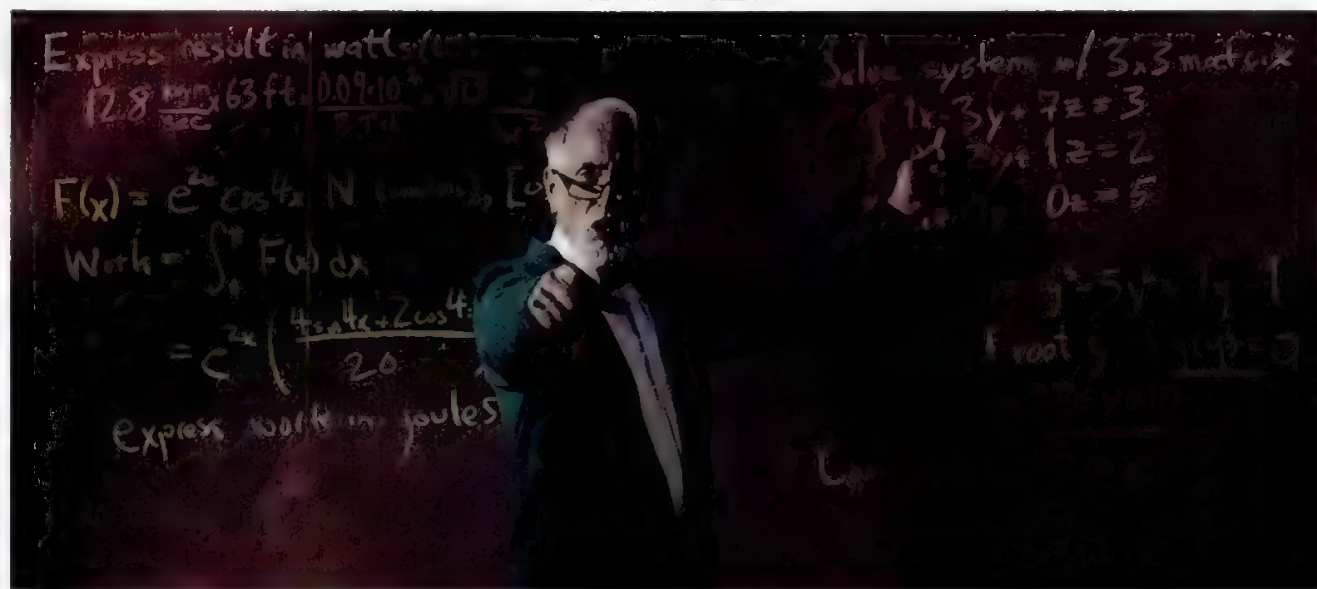
of parallel processing when a coprocessor is present. That's why *Quattro Pro* showed a greater performance increase with a coprocessor than other spreadsheets during PC Labs' testing.

All math coprocessors that claim compatibility with the 80387 have, at minimum, similar characteristics to Intel's products. But individual chip makers have gone their own ways in adding improvements to make their products more competitive, and some have chosen to forgo compatibility entirely.

MEMORY-MAPPED MATH CHIPS

Memory-mapped coprocessors, such as Weitek's Abacus line of math coprocessors (see the sidebar "What about the Weitek?" for more information), communicate with your programs and microprocessor by using memory addresses as mailboxes. A small range of addresses (typically a 4K page) in far off paragraphs of your system's RAM (well above the 16MB that most 80386-based computers can use for physical RAM but within the 4GB addressing range of the microprocessor) is cordoned off for such commu-

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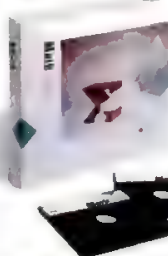
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Vice President, Sales

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MATH COPROCESSORS

nications. The microprocessor pushes instructions for the coprocessor to one group of addresses and pushes data to another. The coprocessor responds with its results in the same manner. No actual RAM chips are installed at these locations. Rather, the memory for holding the commands and data are part of the coprocessor's circuitry.

One obvious requirement of the memory-mapped design is that the coprocessor must have access to the address lines used by the microprocessor. I/O-mapped coprocessors have no need for this address information, so address lines aren't available at coprocessor sockets designed for 80387 chips. Memory-mapped coprocessors require larger sockets with more pins to accommodate all the address lines they need. That's why memory-mapped coprocessors have sockets the size of those used by 80386 microprocessors while 80387 sockets are smaller. These special sockets for memory-mapped coprocessors are termed EMC sockets (for Extended Math Coprocessor interface). Theoretically, a memory-mapped coprocessor can be faster than an I/O-mapped chip because the exchange of commands and data through memory is quicker than through the I/O route. While I/O-mapped chips must move instructions and data in separate operations over several clock cycles, memory-mapped chips can acquire all the data and instructions they need in a single operation. Once the information has been loaded into its memory range, the memory-mapped coprocessor is on its own. The I/O-mapped coprocessor requires more time-costly hand-holding.

The big disadvantage of the memory-mapped coprocessor is that its interface hasn't yet been standardized. Each memory-mapped coprocessor has its own commands and uses its own distinct address range. In order to take advantage of the coprocessor, programs must know these secrets, so each memory-mapped coprocessor requires its own version of a particular application. Few programs actually have such built-in support.

THE CYRIX ALTERNATIVE

Although Intel licensed other chip makers to produce its microprocessor and coprocessor designs for the 80286 and 80287 families, the company has staunchly refused to license the 80386 and 80387. The newer and more powerful chips have been immensely profitable for Intel, and



FACT FILE

Cyrix EMC87

Cyrix 83D87

Cyrix Corp., 1850 N. Greenville Ave., Ste. 184, Richardson, TX 75081; (800) 327-6284, (214) 234-8387.

List Price: 20-MHz EMC87, \$774; 25-MHz EMC87, \$865; 33-MHz EMC87, \$994; 20-MHz 83D87, \$647; 25-MHz 83D87, \$814; 33-MHz 83D87, \$994.

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IIT 3C87

Integrated Information Technology Inc., 2445 Mission College Blvd., Santa Clara, CA 95054; (408) 727-1885.

List Price: 16-MHz 3C87, \$439; 20-MHz 3C87, \$499; 25-MHz 3C87, \$639; 33-MHz 3C87, \$779.

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i486 CPU

387-33 Math CoProcessor

Intel Corp. 3065 Bowers Ave., Santa Clara, CA 95052-8065; (800) 538-3373.

List Price: 387-33 Math CoProcessor, \$994; i486 CPU, \$953.

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entrepreneurs have enviously eyed those profits. Two groups, Cyrix and IIT, are trying to share in that wealth by creating their own compatible coprocessors.

Cyrix Corp. was founded in 1988 to design and market advanced solid-state components. The company decided to develop Intel-compatible math coprocessors as its first product because of the ready market in an area without significant competition. Its first FasMath series of coprocessors was introduced in October 1989. Called the 83D87, these are pin-compatible replacements for the Intel 80387. A lower-cost version for 80386SX computers, the 83S87 was introduced in March 1990.

The Cyrix products are designed to be completely compatible with Intel's 80387 family, although they're not copied through traditional methods (x-ray a chip and determine its internal layout). Instead, Cyrix engineered its coprocessors with an entirely different logic design based on the documented and undocumented functions of Intel's products.

Perhaps the most important difference is that the Cyrix chips rely more on hard-wired logic than microcode. From this alternative design, they can achieve sub-

stantially greater speed than Intel's chips on floating-point operations.

Hard-wired logic is exactly what it sounds like. The bit patterns that make up commands directly trigger state changes in the solid-state circuitry. Each pattern—each logical instruction—must be specifically designed into the coprocessor's hardware.

In microcode designs, instructions sent to the microprocessor cause the chip to run through several steps that make up a miniature internal program. The internal program tells the more general purpose logic of the chip to carry out the function required.

The microcode design is the more structured approach. It gives the designer greater flexibility and can help get products to the market faster. It also allows complex instruction sets to be handled by general purpose circuits. But microcode can slow down the chip's thinking process. Executing the microcode imposes yet another layer of overhead on every calculation.

PC Labs' tests show that the different design approach taken by Cyrix has a pronounced effect on floating-point performance. On PC Labs' floating-point benchmark tests, the Cyrix 83D87 proved nearly twice as fast as its Intel equivalent. Performance on commercial application software, though, showed less of a difference. Even on the most math-intensive tasks, the Cyrix 83D87 was only able to best the Intel 80387 by about 10 percent—if at all.

Clearly, with standard applications, performance alone is not a compelling reason to choose the 83D87. However, the 83D87 never did substantially worse Intel's 80387, so a low street price might make the Cyrix choice compelling. The two companies' list prices for their products are much the same, however. The 83S87 is available in two versions, 16 MHz priced at \$506 and 20 MHz priced at \$556. Four versions of the 83D87 are available: 16 MHz goes for \$570, a 20-MHz model for \$647, the 25-MHz version runs \$814, and the 33-MHz chip sells at \$994.

THE CYRIX EMC87

Cyrix hopes to legitimize itself as more than merely a maker of clone chips. The company has sought to vault past the inherent limitations of I/O-mapped coprocessors. Its new EMC87 chip was developed as a memory-mapped replacement for the 80387. The EMC387 is

based on the same processor architecture as the 80387, with eight 80-bit registers, and it has essentially the same command set. Its bus control logic has been completely revamped, however, to the extent that Cyrix claims a fivefold improvement over Intel.

Even getting near that speed requires software particularly written for the EMC87. Applications that support the Intel 80387 use only I/O-mapped instructions. Moreover, the EMC87 is incompatible with code written for the Weitek family because the two chip families have entirely different architectures for their floating-point units.

Because the EMC87 is memory-mapped, it requires access to all the address lines used in 80386 computers. Hence, it has a full complement of 112 pins and fits into the EMC socket normally reserved for a Weitek coprocessor.

Understanding the need for software availability to reap the benefits of the chip, Cyrix offers a code converter which adapts assembly language code from I/O-mapped to memory-mapped instructions for the EMC87. This code-converter will work with any assembly language file, including those produced by higher-level language compilers, such as Pascal or C. While these free code-converters may be interesting for software developers, they're of no value to an end user. They cannot convert commercial applications to make them compatible with the EMC87.

Knowing that no one would want a product that won't work with any available software, Cyrix has engineered an "interim ad infinitum" solution into the EMC87. The chip also understands Intel-style I/O-mapped instructions, and will deliver performance equivalent to the Cyrix 83D87 on programs written for the 80387. In fact, the floating-point units inside the 83D87 and EMC87 are identical; the chips differ only in their bus control logic. The EMC87 thus offers current compatibility along with the promise of further acceleration in the future.

Until—and if—software publishers opt to take advantage of the EMC87, the chip will remain more a curiosity than an added enhancement. But because the 33-MHz EMC87 is priced the same as the 83D87 (\$994), it offers a promise of future performance at no additional cost. (Slower EMC87 chips are somewhat more expensive than their I/O-mapped equivalents. A 20-MHz EMC87 lists for \$774; the 25-MHz version for \$865.) For anyone who

has a computer with the necessary EMC socket, the EMC87 could be an intriguing investment.

ANOTHER CHALLENGER

Integrated Information Technology is at heart a coprocessor company. Founded in 1988 by two engineers who left Intel to work for Weitek (one was actually a co-founder), the company now offers chips compatible with Intel's 80287 and 80387. As with the Cyrix products, those from IIT were developed from the ground up rather than reverse-engineered. Both are

If your applications comprised nothing but floating-point operations, you'd get more speed from adding a coprocessor than waiting for the next two or even three generations of new microprocessors. But no computer program consists of nothing but floating-point operations.

CMOS designs based on 1.2-micron technology.

The IIT coprocessor design has 32 80-bit registers instead of a mere eight. These registers are divided into four banks and are designed to facilitate 4-by-4 matrix math, which can accelerate drawing performance in graphics applications. Using just one of those four banks simulates an I/O-mapped coprocessor. Using all four requires special programs written for the IIT. So far only Schroff Development's (913-262-2664) *SilverScreen* and Evolution Computing's (602-967-8633) *FastCAD 3-D* take advantage of the 4-by-4 matrix instruction.

IIT claims that the 3C87 can calculate 50 percent faster than an Intel 80387. On benchmark tests and actual application software, we saw no significant performance advantage.

Unlike the Cyrix chips, the IIT coprocessors don't exactly duplicate the operation of the 80387. The error handling of the Intel and IIT chips differs, much as it does between the 80287 and 80387. Some chip makers have exploited that difference by writing special programs that show anomalous results when run on the IIT chips. With a bit of the P. T. Barnum School of Salesmanship, they

claim that such results prove the 3C87 is inaccurate.

According to IIT, however, such odd answers only crop up when you purposely try to exacerbate the error-handling differences by dividing by a near-zero number, such as 10^{27} . On normal application software, no anomalous results should appear. In fact, PC Labs detected no odd answers or incompatibilities in testing with commercial application software.

IIT acknowledges that an early iteration of its 3C87 chip did have an internal bug that resulted in errors in using its arctangent operation when running *AutoCAD* under Unix. This bug was corrected

in June 1990, and the company reports that no other problems have since been reported.

WILL THEY WORK FOR ME?

Now that we've defined math coprocessors, a nagging question remains that needs a definitive answer: Do math coprocessors actually accomplish their goal—do they work? An equally important question is whether a coprocessor will deliver increased performance on the applications you use—will it work for you? PC Labs set out to find answers for these questions using the software that most *PC Magazine* readers use. The results may give you pause.

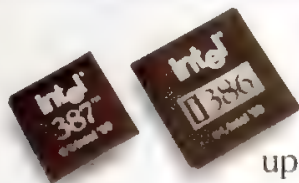
On the surface, coprocessors acquit themselves well. They deliver substantial performance improvements on floating-point operations—their precise design goal. On PC Labs' floating-point benchmark tests (a mixture of floating-point problems designed specifically to test a coprocessor's effectiveness) opting for any coprocessor delivered calculations in about one-tenth the time the standard microprocessor took. If your applications comprised nothing but floating-point operations, you'd get more speed from adding a coprocessor than waiting for the next

MATH COPROCESSORS

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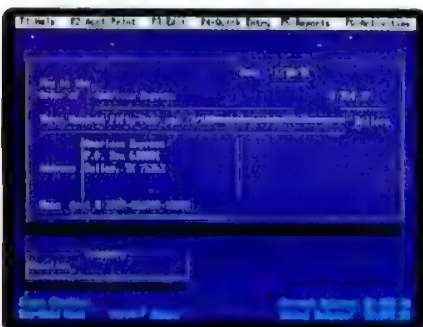
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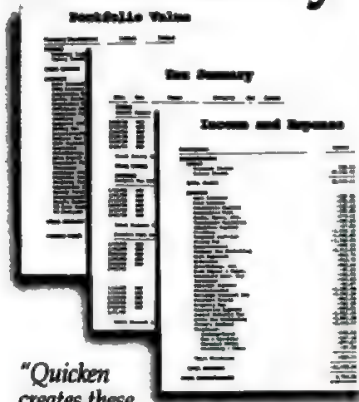
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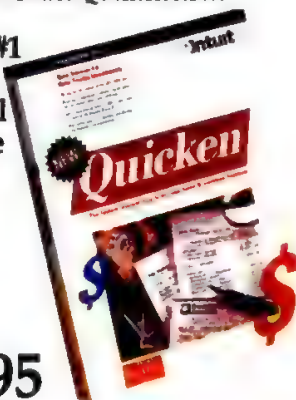
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two or even three generations of new microprocessors.

But no computer program—with the exception of benchmark tests—consists of nothing but floating-point operations. In fact, even the most number-intensive applications make scant use of them.

PC Labs examined the most popular of math-hungry application areas—spreadsheets. We compared the performance of the three best-selling spreadsheets with and without a coprocessor using a number of different scenarios. The spreadsheets were *Lotus 1-2-3*, Release 2.2; *Quattro*

however, the availability of a coprocessor began to prove its value. Recalculations accelerated to more than three times as fast in some cases. But the tenfold improvement seen in executing the benchmark tests—and the hundredfold improvements claimed by chip makers—were as elusive as free roaming unicorns when running actual applications.

Even on heavy-duty calculations, most applications only devote a small percentage of their code to the actual math. They

Labs found the results under application software a dead heat. No one math coprocessor distinguished itself as substantially faster than the others on commercial software. That result is a function of the software rather than the coprocessor hardware.

Certainly, PC Labs' floating-point benchmarks point to a performance edge for the Cyrix chip with IIT close behind and the Intel 80387 the slowest. But standard application software imposes so much overhead that these performance differences were swamped. You can expect to find only a 1 or 2 percent difference between the fastest or slowest 80387-compatible coprocessor under most commercial software. That's hardly worth worrying about. You're better off shopping for the best price.

The only definitive difference we saw was using Intel's 80486 microprocessor. In every test, it was substantially faster than any 80386/387 combination. Part of that advantage may have been won by the larger RAM cache on the Compaq processor platform, but much of the credit is due to the superior design of the 80486. When performance counts, an 80486 is a better choice than any 80386/387 combination operating at the same clock speed.

This proven superiority could hint at the demise of math coprocessors. After all, one of the reasons for the existence of coprocessors—the technical inability to construct microprocessor circuits of the necessary complexity—no longer applies.

But an 80486 microprocessor still costs as much or more than an 80386/387 combination. And only about 10 to 20 percent of all available coprocessor sockets in the 50-million-plus PCs now on desktops are filled. That leaves a substantial market for coprocessors, one that the chip makers believe will keep them in business for years to come.

Should you contribute to their profits? If you have an application that demands floating-point work, you'd be foolish not to. Even with a "mere" 50 percent performance improvement on spreadsheet recalculations, there's no more cost-effective speed boost you can give your PC. Plug in any of the three 80387-compatible chips, and you'll be a believer in the magic of math coprocessors. ■

Winn L. Rosch is a contributing editor of PC Magazine. The testing for this story was performed by Stephen W. Plain, a PC Labs system support specialist.

**Even on heavy-duty calculations, most applications
only devote a small percentage of their code to the
actual math. Consequently, only a fraction of the work
done through any commercial application relies on
the coprocessor's power.**

Pro, Version 1.1; and *Microsoft Excel 2.1D* running under *Windows 3.0*. A Compaq Systempro served as the test-bed, equipped with a 33-MHz 80386 processor with 64K RAM cache and a 486 processor board with 512K RAM cache for comparison. The system was equipped with 12MB of RAM and two pairs of 210MB hard disks. All tests were conducted under DOS 4.01.

One spreadsheet test involved the recalculation of a complex loan, representative of the issues and mathematics involved in financial analysis. Adding a coprocessor didn't change performance significantly, but such results should not be unexpected. Most financial calculations involve little more than simple arithmetic—addition and subtraction—operations on which a math coprocessor yields no benefit.

Again, when the spreadsheets were used as databases and their speed in sorting through records was measured, coprocessors delivered no measurable performance improvement. For the most part, sorting involves instructions to compare strings which aren't affected by the presence of a coprocessor. Complex sorts also call into play mass storage devices, the performance of which is unaffected by the presence of a coprocessor.

When the spreadsheets were called upon to calculate arrays of irrational numbers and trigonometric functions,

also need to devote time to processing display information, disk operations, and other housekeeping functions that aren't aided by coprocessor operation. Consequently, only a fraction of the work done through any commercial application relies on the coprocessor's power.

To gain any performance improvement from a coprocessor, you must use transcendental functions. Typical accounting calculations have no such requirement (unless, perhaps, you're planning for the hereafter). Engineering and scientific chores are those most likely to require transcendentals. Financial calculations that involve compound interest and the like will also take some advantage of a coprocessor.

CAD programs all benefit from the addition of a math coprocessor, but the advantage gained varies with the operation carried out. Loading images and screen regenerations can be handled in about half the time when a coprocessor is available. Hidden-line removal time decreases little more than 10 percent.

Of course, no matter the application, normal data entry performance won't change at all with the addition of a math coprocessor. Nor will the speed of standard DOS operations.

CHIP VS. CHIP

When it came to running a horse race between these coprocessing products, PC



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CIRCLE 732 ON READER SERVICE CARD

by
Michael Mefford

Utilities

Maintaining an expense account is an irksome chore; however, as *PC Magazine* staffers have learned on our Editors' Day trips, it's the only way to get reimbursed for out-of-pocket expenses when you travel or entertain clients for your company. The nightmare is always the same: gather together your scattered notes and receipts, categorize the expenditures under the headings the bean counters will accept, add up the categories and add up the totals, then deduct any advances or company-paid expenses.

A lot of this would be easier if you could enter the expenses on a computer form as they accrued. Then, when the outstanding balance was large enough to warrant filling out an expense report, you would simply hit a key to print out a report that you could submit as is or use to speed completing your company's official expense account forms. JOURNAL.COM, this issue's utility, does just that.

As displayed in Figure 1, JOURNAL's data entry form provides a number of fields that should cover most common business expense categories. Once the appropriate fields are filled out with your expenses, you can quickly get the outstanding balance with a touch of the key. If the balance is enough to warrant filing, another key-stroke will give you a complete itemized report.

Since a calendar is an integral part of keeping a journal, and since an appointment scheduler probably appeals to the same person as one who needs to track his expenses, I decided to include the same functions in JOURNAL.COM that were built into SCHEDULE.COM (*PC Magazine*, March 27, 1990). As with that earlier program, JOURNAL can be used either directly from the DOS prompt or as a memory-resident (TSR) program you can pop up over another running application.

You can download an executable copy of JOURNAL.COM from PC MagNet by following the instructions given in the accompanying sidebar "JOURNAL by Modem." If your modem setup can't accept

Handle Your Expense Account the Easy Way With JOURNAL.COM

■ This handy utility not only helps you keep track of expenses and lets you know when they're big enough to submit, but gives you a complete appointment scheduler, as well.

binary files, just download JOURNAL.BAS and run that program once in BASIC to create the .COM file. The assembly language source code, JOURNAL.ASM, is also available for downloading from PC MagNet. It requires use of a macro assembler (IBM or Microsoft, Version 2 or later)

and the following command sequence:

```
MASM JOURNAL;  
LINK JOURNAL;  
EXE2BIN JOURNAL JOURNAL.COM
```

You can then delete the .OBJ and .EXE files created in the process.

If you do not have a modem, you can also get the source code by mail or fax by sending a *postcard* with your name, address, and fax number (if applicable) to Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; Attention: Katherine West. No phone calls, please.

USING JOURNAL

The full syntax for executing JOURNAL is as follows:

F2 Save F3 Today F4 Purge F5 Report F6 Clear F7 Appointment F8 Help/Quit
Journal © PC Magazine © Michael J. Mefford Nov 13 1988 Tue 18:17pm

BUSINESS PURPOSE: CHURCH
TRAVEL:
Taxi: \$14.50 Auto (local):
Train/Bus: Auto (park./mileage):
Airfare: Parking:
Toll: Other:
LODGING: \$24.00
MEALS:
Breakfast: \$7.75 Lunch: \$11.00 Dinner: \$11.00
ENTERTAINMENT:
Account: \$133.00
Place: Home's
Nature of expenditure: Dinner
Persons entertained: B. Smith, E. Johnson
Purpose: Discuss new product
TELEPHONE/FAX: \$5.65
OTHER:
ADVANCE:
COMPANY PAID EXPENSES:

Figure 1: The JOURNAL data form provides all the fields you will normally need in preparing a day-by-day expense account. You can output the reports either to a printer or to an editable file.

Utilities

```
JOURNAL [/I] [/U] [/Hn] [/Pn...n]
[/G] [/A] [/C] [/M] [/B]
```

Entered without the /I switch, JOURNAL runs as a standalone DOS application. The /I switch installs it as a memory-resident pop-up with Alt-J as its default hotkey. JOURNAL needs 23K of RAM to run as a TSR, but with an operating shell like 386MAX, you can LOADHI JOURNAL to install it above the 640K DOS barrier. If no other TSRs have been loaded subsequently, you can uninstall JOURNAL by entering JOURNAL /U. Note that JOURNAL must be installed *before SideKick* if you use that program.

Because hotkey conflicts are so common among TSRs and applications, I've made it easy to change the JOURNAL pop-up key. By using the /H option you can select any alphanumeric Ctrl- or Alt-key combination for the program. Thus, to change the hotkey to Ctrl-K, you would enter

```
JOURNAL /I /H Ctrl K
```

The /I parameter tells JOURNAL to install itself, and the /H command tells it to use Ctrl-K as its hotkey. Note that when using the /I option, you type the actual letters ctrl (with *no* following hyphen) on the command line. You can change the hotkey at any time, even after installation, simply by entering JOURNAL again with /H and the new hotkey desired. Using the /I switch a second time is unnecessary if you just want to change the hotkey.

The /P and /G command-line options are printer enhancements. You use /Pn...n to enter a printer setup string, where n...n represents up to ten decimal printer codes. For example, if you have a LaserJet or compatible printer and you want your appointments or expense journals printed in boldface, you would enter

```
JOURNAL /P 27 40 115 66
```

JOURNAL's reports can make use of the IBM extended-ASCII line-drawing characters. If your printer does not support this character set, however, attempting to print the line-drawing characters may result in a mishmash of nonsense text characters. To avoid this, JOURNAL by default sends the standard text characters—dash,

vertical bar, plus sign, equal sign, and asterisk—to the printer, replacing the line-drawing characters you see on your screen.

If your printer *can* handle the line drawing characters, however, just tell JOURNAL by adding the /G graphic character command-line switch. This produces a much neater printout. Some printers can be switched into an emulation mode that recognizes the IBM line-drawing characters. Check your printer manual and add the codes to the /P printer setup string along with the /G switch.

The /B switch forces JOURNAL to use black-and-white attributes. Some color monitors display only eight colors or color combinations, which lack proper contrast.

This applies especially to portables with LCD displays. If you find that JOURNAL is hard to read in color, use the /B switch or customize JOURNAL's color scheme using the instructions provided in the sidebar "Customizing JOURNAL."

JOURNAL includes the appointment-keeping features of SCHEDULE.COM, and the remaining three command-line parameters apply to this portion of the program. The details of using the SCHEDULE appointment screen are more fully provided in our March 27, 1990, issue, and its DOS manual lookalike page can be downloaded from PC MagNet. Briefly, however, when installed as a TSR, the appointment section of JOURNAL can re-

CUSTOMIZING JOURNAL

by Michael J. Mefford

These instructions let you customize JOURNAL's color scheme and change the tone of SCHEDULE's chime. First make a backup copy of JOURNAL.COM and then enter

```
DEBUG JOURNAL.COM
```

You are now ready to modify JOURNAL.COM. If at any time you make a mistake, you can abort the editing process by entering Q. The last two commands that you enter after entering your modifications are

```
W
Q
```

(for Write to disk and Quit DEBUG.)

COLOR SCHEME

Enter the following DEBUG Enter instructions, replacing the xx with a hexadecimal color value. The default color values and descriptions that JOURNAL uses are to the right of the semicolon for each address:

```
E 8E1 xx ; 17 White on blue
E 8E2 xx ; 71 Blue on white
E 8E3 xx ; 1E Yellow on blue
E 8E4 xx ; 3B Bright cyan on cyan
E 8E5 xx ; 1B Bright cyan on blue
E 8E6 xx ; 7E Yellow on white
```

For example, if you wanted to change the yellow on blue (1E) color scheme to

red on blue (14), you would enter

```
E 8E3 14
```

The hexadecimal values of the colors you can select are

Dark colors	Light colors
0 Black	8 Dark gray
1 Blue	9 Lt. blue
2 Green	A Lt. green
3 Cyan	B Lt. cyan
4 Red	C Orange
5 Magenta	D Violet
6 Brown	E Yellow
7 Lt. gray	F White

CHIME TONE

The value used to calculate the tone of the chime is a hexadecimal number that can range from a low of 0025h to a high of 1150h. The default value is 0416h. You'll find numbers close to the default more pleasing. To change the tone of the chime, enter

```
E 8EE yy xx
```

where xyy is the new tone divisor. For example, to change the tone from a C note (a value of 0416h) to an A note, enter

```
E 8EE 70 03
```

where A has a divisor of 0370h. ■

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mind you at the times you have scheduled appointments by chiming and popping up its display. Similarly, it can pop up at midnight to get the next day's events.

You may not want any of these conditions: the chime may annoy nearby co-workers; the automatic appointment pop-up should not be active when you are running a communications program; and if you intend to run a long program overnight, you don't want it frozen at the point it reached at midnight. So the default for all three of these options is OFF. To turn ON these options, simply load JOURNAL with /C, /A, and /M, respectively.

If you forget the syntax for any of these commands, just enter JOURNAL ? to display an explanatory list of all of them.

Two additional notes are in order. First, JOURNAL is a text-based program. That means you can not pop up JOURNAL over a graphics screen, such as that of *Microsoft Windows*. If you try, JOURNAL will complain with a short beep. Nor can JOURNAL pop up when DOS is busy doing something else or when there is disk activity. JOURNAL will notify you that it can't pop up with two short beeps.

Second, so that JOURNAL can know where to store its data files, you must be in the directory in which it is stored in order to run it. Although you can keep JOURNAL in any directory you like, I strongly suggest that you make a separate directory, perhaps named JOU, to house JOURNAL.COM and the four files it creates: SCHEDULE.DAT for appointment data; SCHEDULE.ASC for archived purged appointments; JOURNAL.DAT for journal data; and JOURNAL.ASC for archived purged journals. (Archiving and purging will be discussed later.) Assuming you follow this suggestion and make a directory JOU on the C: drive, you can then create the following batch file, called J.BAT, which will change to that directory and run the program automatically:

```
c:
cd \JOU
JOURNAL %1 %2 %3 %4
cd \
```

The short name means you have only to enter J instead of JOURNAL, and the % parameters will pass on any command-line options you type in at the same time. Natu-

JOURNAL COMMANDS

Key	Journal	Appointment	Calendar
PgUp/PgDn	Previous/next day	Previous/next day	Previous/next month
Ctrl-PgUp/Ctrl-PgDn	Previous/next month	Previous/next month	Previous/next year
Arrow keys	Navigation	Navigation	Navigation
Home(1)	Start of field	Start of section row	Start of week
Home(2)	First field	Top of section	Start of month
End(1)	End of field	End of section row	End of week
End(2)	Last field	End of section	End of month
Ctrl-Home	First field	Start of section	Start of month
Ctrl-End	Last field	End of section	End of month
Ctrl-Left Arrow	Start of field	Start of section row	Start of week
Ctrl-Right Arrow	End of field	End of section row	End of week
Tab	Next field	Next section	
Shift-Tab	Previous field	Previous section	
Del	Delete character	Delete character	
Backspace	Delete previous character	Delete previous character	
F2	Save Journal	Save appointments	
F3	Today	Today	Today
F4	Purge Journal	Purge appointments	
F5	Report Journal	Print appointments	
F6	Clear line	Clear line	
Shift-F6	Clear all fields	Clear section	
Ctrl-F6	Clear all fields	Clear all sections	
F7	Appointment	Calendar	Journal
Esc	Return to Calendar	Return to Calendar	Exit JOURNAL

You can use the hotkey to directly exit the journal or the appointment screen without stopping at the Calendar.

JOURNAL Report Submenu (F5)

F6	Total only
F7	Send complete report to LPT1
F8	Send complete report to LPT2
F9	Send complete report to file

JOURNAL Purge Submenu (F4)

PgUp/PgDn	Previous/next day
Ctrl-PgUp/Ctrl-PgDn	Previous/next month
F3	Today
F7	Purge up to and including date
F8	Purge date only
Esc	Cancel

If archive is selected, appointments are saved in SCHEDULE.ASC and journals are saved to JOURNAL.ASC.

rally, you must modify the drive and path arguments if you choose to store JOURNAL somewhere other than in C:\JOU.

OPERATION

JOURNAL has three screens: Calendar, Journal, and Appointment. You can move from one to the next by repeatedly pressing F7; Shift-F7 reverses direction. Pressing Esc from the Calendar screen exits the program, and pressing Esc twice exits from either of the other two screens. Pressing the hotkey while JOURNAL is active exits directly.

The sidebar "JOURNAL Commands" lists all the command keystrokes for the three screens, but you'll really be able to

get along using those listed at the top of each screen. Note that the Calendar screen reflects appointments you enter and save by "blocking" them out.

Once in either the Journal or the Appointment screen, you can use the Arrow keys to navigate. The Tab and Shift-Tab keys move you among the three sections of the Appointment Screen (6:00 A.M. to 1:30 P.M.; 2:00 P.M. to 9:30 P.M.; and mininotepad) and can also be used to go from one expense field to the next of the Journal Screen. In either screen, F2 saves what you have entered, and pressing Esc twice (or the hotkey) will get you out. To print out your appointments, simply hit F5 and pick your printer port (1 or 2).

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When you press F5 from the Journal screen, the program does all the arithmetic needed to tally up the expenses you have entered *for all days up to, and including, the current date*. You can change the report date with the PgUp and PgDn keys, however, so if you want the current day's

entries included, you simply press PgDn to advance the report date by one day.

You can choose between two report types. Having hit F5, if you press F6 you'll get an overall, bottom-line figure that is displayed in a box. This Total Only option lets you see how much you have outstanding, so you can decide if it's worth it yet to submit a full report.

The F7 and F8 Complete Report options output (via LPT1 and LPT2, respec-

tively) the complete form for each of the days for which you have previously entered expenses. Or by pressing F9, you can have a Complete Report saved to a file called JOURNAL.DAT, which can subsequently be imported by a word processor. The printed report displays two days' forms neatly on one standard-size page.

Whether you output the JOURNAL report to a printer or to a file, at the bottom of each day's form will be the TOTAL for

DECIMAL ADDITION

by Michael J. Mefford

In discussing my COMPUTE.COM utility (*PC Magazine*, May 29, 1990), I explained how difficult it was for computers to deal with real numbers, that is, numbers that have decimal fractions. Computers work best with base 2 (binary) numbers, rather than the base 10 number system we humans use. One way to handle real numbers is with floating-point notation. Floating-point notation is rather complicated, however. The solution in COMPUTE was to use BCD (binary-coded decimal) arithmetic with a fixed decimal position. BCD uses a byte to store each digit and works well with numbers that have a large number of decimal places.

JOURNAL also has to do decimal arithmetic, of course, but in this case it has only to add and subtract the monetary numbers it receives, and it needs only a fixed two decimal places to handle the cents. Both floating-point and BCD would therefore be overkill.

Instead, JOURNAL takes advantage of its internal ability to use all four arithmetic operations and uses a simple trick to keep track of the two-place decimal point. All decimal ASCII numbers are converted to binary and multiplied by 100 before they are added together. They are then divided by 100 and converted back to ASCII when it's time for output. This technique is often referred to as the *penny count*.

Thus, for example, to add \$23 and \$.50, JOURNAL converts both numbers to pennies: the first to 2,300 and the second to 50. Then it adds the two, making 2,350. Dividing by 100 converts the number back to \$23.50, which effectively restores the two fixed decimal places. Figure A shows the code

for the JOURNAL procedure ACCUMULATE, which takes a numeric string and converts it to a 32-bit integer that is the number of pennies represented by the input number (or 100 times the input value).

ACCUMULATE starts by initializing a 32-bit sum to zero and initializing a decimal position counter to 2. The data field is read from left to right searching for either numbers or a decimal point. If it encounters dollar signs, it ignores them. However, all other characters generate an error beep.

When a number is encountered, the previous sum is multiplied by 10 and the new number is added in. If a decimal point is encountered, it is noted (DECIMAL_FLAG=1) and the next two numbers encountered, if any, decrement the decimal place counter. So with the \$23 field, ACCUMULATE starts with zero, multiplies that by 10 when the 2 is found, resulting in zero, of course, and adds in the 2. When it finds the 3, 2*10 becomes 20 and the 3 is added in. It doesn't find other numbers or the decimal point, so the DECIMAL_CNT remains at 2, meaning ACCUMULATE must multiply the 23 by 10 twice, or 100. The result is 2,300.

With the \$.50, ACCUMULATE first sees the decimal point and takes note of it. When the 5 is found, it is added in to the initial zero sum as above, but the DECIMAL_CNT is also decremented, since the 5 is after the decimal point. After the 0 is added in, the DECIMAL_CNT becomes zero, meaning the number has already been multiplied by 100.

When it comes time to output, the AMOUNT_ASCII procedure also shown in Figure A converts the number

back to a 2-place decimal number by dividing by 100. The remainder of the division is the decimal portion and the quotient is the integer portion. Before dividing by 100, AMOUNT_ASCII checks for a possible overflow result called "Division by zero."

DIVISION BY ZERO

When a 32-bit number in DX:AX is divided by a 16-bit number (BX in AMOUNT_ASCII) the resulting quotient must fit in AX and the remainder is put in DX. If the quotient is too large (larger than 0FFFFh), then an INT 0, or "Division by zero," interrupt is generated by the CPU. INT 0 usually points to a DOS routine that simply displays one of its notorious brief and nebulous messages, "Division by zero" and rudely aborts the program, leaving you back at the DOS prompt.

Maybe you've been disquieted by the "Division by zero" message and said to yourself, "But I didn't divide anything by zero." "Division by zero" is often a misleading description. "Division overflow" would better describe it, as the above CPU division rule suggests. Dividing a very large number by a small number will result in such an overflow. However, I think it rather appropriate that the "Division by zero" interrupt is assigned to INT 0.

A program can avoid "Division by zero" interrupts in one of two ways. One is to have it install its own INT 0 handler, which can inform the user about the problem and suggest an alternative. An easier solution is to make sure that a "Division by zero" error won't occur before dividing.

AMOUNT_ASCII has such a trap. The check is quite simple: the upper 16-

Utilities

that day. The amount entered in the ADVANCE field is automatically subtracted from each day's total; the COMPANY PAID EXPENSES fields are tallied separately and not entered into the total. At the end of the report comes the total of all COMPANY PAID EXPENSES and the

GRAND TOTAL of all the TOTALS from each day. You can press Esc at any time to cancel a report.

Once you've prepared a written report of your expenses, you should purge the forms for the dates covered. Otherwise, those days will suspiciously reappear the next time you prepare a report. The Purge dialog box is automatically displayed after you print a report. Pressing F7 purges data up to and including the displayed purge

date; F8 purges the displayed date only. You can change the purge date the same way as with the Report date, namely, with the Paging keys. To purge past appointments, you follow the same procedure, this time starting from the Appointments screen.

After selecting the type of purge (F7 or F8) you will be given the option to save the data to an archive file for later reference. Answering yes will save the data to a file

ACCUMULATE PROCEDURE

```

; INPUT: SI -> Journal field; OUTPUT: DI:AX = number * 100.

DECIMAL_FLAG DB ? ; =1 if decimal point found.
DECIMAL_CWT DB ? ; Initialized to 2.

ACCUMULATE: PUSH BP ; Preserve.
             MOV DECIMAL_FLAG,0 ; Initialize flag
             MOV DECIMAL_CWT,2 ; and counter.
             MOV CX,NUM_SIZE ; Length of field.
             XOR DI,DI ; DI:BP = number; zero to start.
             XOR BP,BP

NEXT_ACC: LODSB ; Decimal point?
          CMP AL,"."
          JNE CX,NON ;
          MOV DECIMAL_FLAG,1
          JMP SHORT LOOP_ACC

CX_NUM: SUB AL,"0" ; Between 0 and 9?
        JB LOOP_ACC
        CHP AL,"9"
        JA LOOP_ACC
        CNP DECIMAL_FLAG,1 ; Decimal portion?
        JNE ACC
        CMP DECIMAL_CWT,0 ; If yes, two decimals yet?
        JE LOOP_ACC ; If yes, skip.
        DEC DECIMAL_CWT ; Else decrement.

ACC: CBW ;
      NCW ;
      CALL MULTIPLY ; Last result * 10.
      ADD BP,AX ; Add in new number.
      INC DI,0

LOOP_ACC: LOOP NEXT_ACC

        MOV AX,BP
        MOV CL,DECIMAL_CWT ; Number of decimal places
        ROR CX,CX ; remaining.
        JCXZ ACC_END
        CALL MULTIPLY
        LOOP NEXT_DEC

NEXT_DEC: CALL LOOP
          RET

ACC_END: RET

; INPUT: DI:AX * 10

MULTIPLY: PUSH DI ; Save high half.
          MOV BX,10 ; DI:AX
          MUL BX ; * 10
          MOV DI,AX
          POP AX ; DI:AX
          PUSH DI ; + DI:AX
          MUL BX ; + DI:AX
          POP DI ; DI:AX

```

```

ADD DI,AX
MOV AX,DI
RET

; INPUT: DI:AX = number; DI -> storage

AMOUNT_ASCII: MOV BX,100 ; Divisor of 100.
               CMP DI,BX ; Will it fit?
               JB AMOUNT_OK ; If yes, no overflow.
               NEG DI ; Else, assume negative and
               NEG AX ; negate.
               SUB DI,0
               MOV BYTE PTR [DI], "-" ; Store minus sign.
               INC DI
               CMP DI,BX ; Assume right? Does it fit?
               JB AMOUNT_OK ; If no, beep and exit.
               CALL BEEP
               JMP SHORT AMOUNT_END

AMOUNT_OK: MOV BYTE PTR [DI], "0"
            INC DI
            DIV BX
            PUSH DX

            MOV BX,10 ; Divisor of 10.
            XOR CX,CX ; Count of ASCII chars.
            CMP CX,3 ; Insert comma delimiter?
            JNE NEXT_AMOUNT2
            MOV DI,","
            PUSH DI
            INC CX
            XOR DI,DI ; Zero in high half.
            DIV BX
            ADD DI,"0" ; Convert to ASCII.
            PUSH DI
            INC CX
            OR AX,AX ; Continue until no integer.
            JNE NEXT_AMOUNT

NEXT_AMOUNT2: POP AX ; Display number.
              STOSB
              LOOP NEXT_AMOUNT2

              MOV AL,"." ; Display decimal point.
              STOSB
              POP AX
              DIV BX
              ADD AX,"0" SHL 0 + "0" ; Display decimal remainder.
              STOSB
              MOV AL,AX
              STOSB

AMOUNT_END: RET

```

Figure A: Since JOURNAL needs only to do simple arithmetic on decimal numbers with two fixed decimal places, it uses the "penny count" technique, in which, after conversion to binary, all numbers are multiplied by 100, summed, and then divided by 100, thus restoring the original decimal point.

bit portion of the number is compared with the divisor, in this case 100. If it is less, it's okay to divide; the quotient will be 0FFFFh or less.

The hex equivalent of 100 is 64h. The largest number that can be divided is 63:FFFFh. The high half 63h portion is less than the 64h divisor. After dividing, the quotient will be 0FFFFh and the remainder 63h. 0FFFFh is 65,535

in decimal and 63h is 99 in decimal. The largest number that JOURNAL can handle, therefore, is \$65,535.99.

If the dividend is larger than \$65,535, AMOUNT_ASCII first assumes that it may be a negative number. Negative sums can result if the ADVANCE field is larger than the sum of the other fields. Remember that the ADVANCE field is the only field that is

subtracted. AMOUNT_ASCII negates the number and then does the Division by zero check again. If it's okay, a minus sign is displayed, and the conversion to ASCII is continued. Otherwise, JOURNAL just error-beeps and aborts the conversion.

A negative balance means you have a credit to your account, a nice situation.

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JOURNAL BY MODEM

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To download JOURNAL.COM, its assembly language source listing, and its BASIC listing, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next menu. Enter the filename, then select the file you want to download from those presented. Answer yes (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

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Michael Mefford

JOURNAL Command

February 12, 1991 (Utilities)

Purpose:

A standalone or TSR (23K RAM) utility that maintains and prints expense-account information and includes the appointment schedule features of SCHEDULE.COM (*PC Magazine*, March 27, 1990).

Format:

JOURNAL [/I] [/U] [/Hn] [/Pn...n] [/G] [/A] [/C] [/M] [/B]

Remarks:

The optional /I switch is used when it is desired to run JOURNAL as a pop-up. The /U switch uninstalls the program if no other TSR has been loaded subsequently. Note, however, that *SideKick*, if used, must be loaded after JOURNAL. The default hotkey is Alt-J, but this can be changed with the /H switch, using any Ctrl or Alt alphanumeric key for n. To install with Ctrl-K as the pop-up key, enter **JOURNAL /H ctrl k**.

The /Pn...n switch allows printer control codes to be entered, with up to ten decimal values for n. For printers that support the IBM extended-ASCII character set, using the /G switch produces a neater printout using the line-drawing characters. With LCD screens, the /B (black-and-white) switch is recommended. The standard color combinations can also be modified with DEBUG, as explained in the main article.

JOURNAL can chime and pop up at the time of a scheduled appointment; it can also pop up at midnight to turn to the next day's events. The /C switch turns on the chime; the /A switch lets the appointment screen pop-up; and /M activates the midnight pop-up. The default for all three options is OFF. Note: Do not activate the automatic appointment pop-up if you're running a communications program.

JOURNAL comes up initially with a Calendar screen and can be switched to its Journal and then to its Appointment screens with F7. Pressing the hotkey exits from any screen; Esc goes back to the Calendar screen, where a second Esc exits. JOURNAL should be run from its own directory, which must be *current* (not just on the path) when it is installed or executed. The program will create and store SCHEDULE.DAT and JOURNAL.DAT in this directory when the Save command (F2) is given from the Appointment or from the Journal screen. The purge command (F4) can be executed from either screen to keep the .DAT files timely. The material removed can be archived by being automatically appended to the files SCHEDULE.ASC and JOURNAL.ASC. The .ASC files can be edited with a word

CONTINUES

processor; the .DAT files can only be edited in the program's screens and then resaved (F2).

The PgUp and PgDn keys change the day displayed in the Journal, Appointment, and Purge screens (the month in the Calendar screen). Ctrl-PgUp and Ctrl-PgDn similarly change the months (years). The current date can be restored immediately by pressing F3. Tab and Shift-Tab move among the three sections of the Appointment screen (the two time columns and the mini-notepad), and from field to field of the expense Journal screen. Pressing Home moves to the start of an expense field, an appointment section row, or the start of the week in the Journal, Appointment, and Calendar Screens, respectively. Hitting Home a second time moves to the first field, the top of the section, or the first of the month for the three screens, in order. Pressing the End key once and twice moves to the corresponding end points of the three screens.

The cursor keys, Del, and Backspace keys work as usual. F6, Shift-F6, and Ctrl-F6 clear lines and fields in the Journal screen, and lines, sections, and all sections in the Appointment screen. The Calendar screen displays blocks that correspond to entries in the Appointment Screen.

Pressing F5 from the Appointment screen prints a list of appointments to the selected port or to a file. When F5 is pressed from the Journal screen, the program tallies all entered expenses for days up to and including the current date. (Use PgDn to advance the day to include the current date). To get an overall total, suitable for deciding whether to file a report yet, press F6. Pressing F7 and F8 after F5 will send a full, day-by-day report to the printer (LPT1 or LPT2, respectively). Pressing F9 after F5 will send the report to a file. The printed report puts two days on a standard-size page. Remember to purge expense account information when a report has been made or it will reappear on the next report.

JOURNAL is a text-based program and will not pop up over graphics screens, like *Microsoft Windows*, or during DOS or disk activity. The largest number the program can handle is 65,535.99.

ENDS

JOURNAL BY MODEM

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

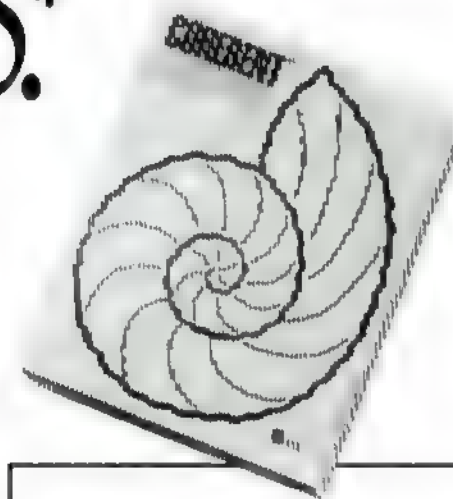
ANSI.COM, Version 1.3
 BEN55.ARC (Benchmark Series, Version 5.5)
 CARDFILE.COM, Version 1.1
 CHKFRAG.EXE, Version 1.2
 DIRMATCH.COM, Version 1.1
 EMS40.SYS, Version 1.1
 LITES.COM, Version 1.1
 LOG.COM, Version 1.1
 PCMANAGE.EXE, Version 1.1
 RN.COM, Version 2.0
 SLICE.COM, Version 1.3
 SNIPPER.COM, Version 1.2
 TPFST-AT.COM, Version 1.1
 ZCOPY.COM, Version 1.2

For a complete list of the programs available from the PC MagNet Utilities Database, download UDCAT.ARC.

A downloadable index to *PC Magazine's* product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine Reviews Index* for January 1988 to June 1990. It requires the search files in PCSRCH.EXE. Please read the information file PCM.INF before you download any of these files.

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No. of Disks	4	21
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Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	\$99.95	\$1495.00

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Utilities

called JOURNAL.ASC in the same directory as JOURNAL.COM. Purged and archived appointments are saved in a similar file, SCHEDULE.ASC. You may do as you wish with these files, including editing them with your word processor.

Your expense data is kept in a file called JOURNAL.DAT, in the JOURNAL.COM directory. SCHEDULE.DAT is the appointment data file. Don't try to manipulate these files on your own: they use a database format that only the two utilities understand. If you're already using SCHEDULE, you'll find that the data in SCHEDULE.DAT is compatible with JOURNAL's appointment screen. That is, you can use the same SCHEDULE.DAT file with JOURNAL and SCHEDULE. Any changes you make in one program will be accepted by the other. If you need to edit an entry in either utility, just bring up that day in JOURNAL and the data will reappear. Edit and press F2 to resave.

The largest number JOURNAL can handle is 65,535.99. If your credits get

SELECTION SORT ALGORITHM			
START:	MOV	SI,OFFSET REPORT_INDEX	;SI = first record.
NEXT_SORT:	MOV	AX,SI	;Carry source pointer in AX;
	MOV	DI,DI	; destination pointer in DX.
	ADD	DI,SIZE REPORT_SORT	;Next record.
	CMF	WORD PTR [BX],-1	;End of index is marked by -1.
	JZ	SORT_END	
	PUSH	SI	;Save record pointer.
NEXT_RECORD:	MOV	SI,AX	;Restore inside loop pointers.
	MOV	DI,BX	
	MOV	CH,SIZE DATE / 2	
	REPE	CMPSW	;Compare the name fields.
	JZ	NO_SWITCH	;If below, no switch.
SWAP:	MOV	AX,BX	;Else, AX = selected record.
NO_SWITCH:	ADD	DI,SIZE REPORT_SORT	;Move to next record in list.
	CMF	WORD PTR [BX],-1	;End of list?
	JZ	NEXT_RECORD	;If no, continue.
	POP	SI	;Else, restore outside loop ptr
	CMF	SI,BX	;Did we make a selection?
	JZ	SELECT_LOOP	;If no, go to next in list.
	PUSH	SI	;Else, save pointer.
	MOV	DI,AX	
	MOV	AX,[DI]	
NEXT_SWAP:	MOV	[SI-2],AX	;Swap the selection into place.
	LOOP	NEXT_SWAP	
	POP	SI	
SELECT_LOOP:	ADD	SI,SIZE REPORT_SORT	;Next record.
	JMP	NEXT_SORT	
SORT_END:	RET		

Figure 2: Journal uses a selection sort to arrange its data files chronologically for output.

larger than that, you have problems that JOURNAL can't solve. To understand

why the limit is such an odd number, see the sidebar "Decimal Addition."

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Utilities

JOURNAL PROGRAMMING CHALLENGE

The JOURNAL and SCHEDULE utilities use the same data file structure followed by the text fields. The records have a single fixed size that includes the day's date both in binary and ASCII format, followed by that day's data fields. When you press the F2 key to save, JOURNAL opens the JOURNAL.DAT (or SCHEDULE.DAT) data file and reads the binary date of each record previously saved. The binary date is compared with that of the record you've requested to save. Putting the date in binary format takes only 4 bytes and speeds the search process.

If no matching date is found, the new data is appended to the file; otherwise, the new record is written over the old. (Remember, in order to save a record, you have to display it on the screen. And when it's displayed on the screen, JOURNAL reads from the file any existing data and displays it. If you make any additions or changes, when you save, you overwrite the old data.) Since there is no guarantee

that the user will save records in chronological order, this means that the records on-disk will not necessarily be in order. That is not a problem for saving or reading the records; paging through the disk file a record at a time goes quite quickly. It's another story, however, when it comes to reporting the records.

Outputting expense reports in chronological order is obviously desirable, so JOURNAL can't simply print out the reports in the order they are stored on-disk. Instead, the records must first be sorted by date. JOURNAL accomplishes this task by first reading just the dates of all the records and storing each date, along with a record number, in memory. The record numbers simply start from zero and increment with each record as it is read from disk. Because of memory constraints, reading and sorting the entire data files themselves in memory would be completely out of the question, especially if JOURNAL is used as a TSR.

JOURNAL thus sorts the dates chronologically, keeping a record number associated with each date. Reading the data involves multiplying the chronologically sorted record numbers by the size of a re-

cord. JOURNAL then can seek the location of that record and print it out.

In PCSORT (*PC Magazine*, November 27, 1990) the sort algorithm of choice was an *insertion* sort, since that technique preserves any existing sorted order. But JOURNAL uses a *selection* sort. Assume you have ten items. In a selection sort you first look through all ten to find the smallest and move it to the front. Then you look through the remaining nine to find the next smallest and move it to the second slot. You follow this technique for the remaining eight. You can find the sort code segment in Figure 2.

If you can coax accounting to accept JOURNAL's forms, the nightmare of tracking and filling out expense forms will almost disappear. Even if you later have to fill out *their* forms, JOURNAL will ease the task considerably. But if anyone has any suggestions for a software solution to the problem of keeping all those darn receipts, I'd love to hear from you! If you have any questions about JOURNAL, you can find me on MagNet. ■

Michael J. Mefford is a contributing editor of PC Magazine.

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PC MagNet News

The Latest Files and Features of PC Magazine's On-line Service

New Labs Benchmark Series Now On-line

PC Magazine Labs recently introduced a new version of its hardware performance tests, now available in the UTILFORUM. Release 5.6 of the PC Labs Benchmark Series incorporates a new 80486 Instruction Mix Test, the ability to save a comma-delimited result file, and improved extended memory performance evaluation. Other improvements were made to the Disk Access and Disk Seek tests, which help evaluate hard disk performance.

Hundreds of thousands of these benchmark test disks have been distributed free of charge. Acknowledged as the industry standard, they are relied upon by both buyers and manufacturers.

Look for BEN56.EXE in the UTILFORUM, DL3 (Lab Notes).

Manage Your Windows Icons

With the interest in *Windows* apparently here to stay, it follows that practical shareware and freeware will continue to make your graphical interface a more personal workspace. MagNet has two useful icon files that can oblige.

The first, IconTamer (ICONTAMR.ZIP), is a complete icon management program. With it you can view, edit, delete, rename or cut icons from the desktop, and also convert .BMP files to icon format. Made available by

Moon Valley Software with a \$15.95 registration fee, this shareware program is a practical device for icon fanatics.

Another way of sprucing up your desktop is to replace the standard DOS icon with a customized icon. Megalcons (MGICONS.ZIP), is a free-ware collection of over 450 color icons for all the major DOS applications.

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by
Charles Petzold

Environments

In the last issue, I presented an overview of color selection under the *Microsoft Windows* Graphics Device Interface (GDI). Color is specified under GDI using a 24-bit red-green-blue (RGB) color value. The 3 bytes for the intensities of the red, green, and blue primaries are stored in the lower 3 bytes of a 32-bit long integer. (This is often called a COLORREF value. Beginning in *Windows* 3.0, a COLORREF value may also specify an index into a palette table, but I will be covering that in a later issue.)

In theory, the use of 24-bit RGB color values gives you access to 16 million different colors. Of course, the video adapters in common use for running *Windows* today are limited to simultaneously displaying 16 colors (in the case of the EGA and VGA) or 256 colors (in the case of the IBM 8514/A and some Super VGA adapters).

When you use an RGB color value to create a brush for filling an area, the color may or may not be available on the video adapter. If the color is not available, *Windows* attempts to simulate the desired color using *dithering*. With this technique, the brush actually consists of a pattern of two (or sometimes three) different-colored pixels that together appear to be the unavailable color. For example, if the video adapter can't represent gray shades, these can be simulated using various combinations of black and white pixels.

When you use an RGB color value to create a pen for drawing lines or to specify the color of text, *Windows* generally will not use dithering. Instead, it finds a pure color available on the video display that best approximates the desired color.

THE COLOR CUBE PROGRAM

I began programming for *Windows* in 1985, and one of the first programs I wrote showed an unfolded RGB color cube. (If you have the August 1986 issue of *PC Magazine*, take a look at the cover story "Achieving the Standard: 12 EGA Boards." You'll see this program's output under

Determining the Colors Available On an Output Device

In theory, the use of 24-bit RGB color values gives you access to 16 million different colors, but current output devices limit the number of available colors. And determining a video board's default colors is no easy task in *Windows*.

Windows 1.0 with various video adapters.) I've enhanced the program a bit, and the code is shown in Figures 1 through 5. If you have the Microsoft C Compiler 6.0 and the *Windows* 3.0 Software Development Kit installed, you can create the CLRCUBE.EXE program by running

```
MAKE CLRCUBE.MAK
```

Or you can download the source files and

CLRCUBE.EXE from PC MagNet.

Figure 6 shows CLRCUBE running under *Windows* 3.0 on a VGA.

In the December 11, 1990, *Environments* column, I discussed various ways to represent and quantify color. Each of these methods requires three parameters. Hence, visualization of the entire range of color requires a three-dimensional coordinate space.

The RGB color model is based on intensities of the red, green, and blue primaries. You can visualize this as a cube, which is often called an *RGB color cube*.

The CLRCUBE program displays an unfolded color cube with six sides. Three of these sides are shown in CLRCUBE along the left edge of the client area. The other three sides extend to the right in the center of the client area. (I'll discuss the two additional squares shortly.)

Each corner of each side is a vertex; the cube has eight. The colors of the vertexes are the three additive primaries (red, green, and blue), the three subtractive primaries

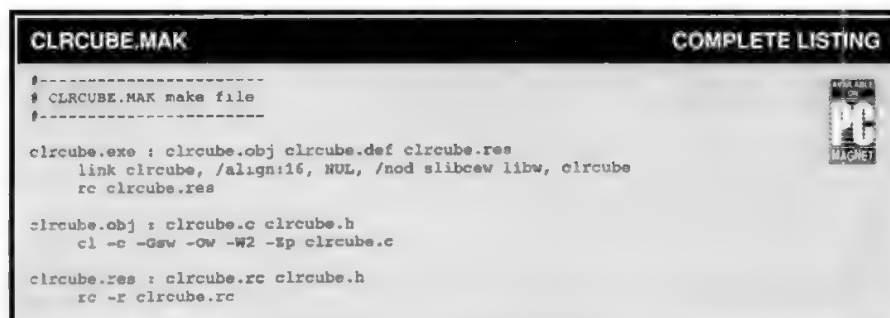


Figure 1: The CLRCUBE.MAK Make file automates construction of the CLRCUBE.EXE executable.

Environments

(cyan, magenta, and yellow), and black and white. In CLRCUBE, black is at the upper-left corner of the client area. White is at the upper-right corner of the cube side that's at the lower-left corner of the client area.

Keep in mind that these six sides of the color cube do not represent the full range of possible colors. These are sides of the cube and don't show any interior areas.

To compensate a little for this deficiency, I've added the two squares just right of center on the top and bottom of the client area. These squares represent diagonals in the interior of the cube connecting opposite corners. Opposite corners of the RGB color cube represent complementary colors.

For example, in the top square, the left side begins with yellow at the top and ends with blue on the bottom. Yellow and

blue occupy opposite corners of the color cube and are complementary colors. The right side of the top square shows the progression from white to black. These are gray shades. Each of these two additional

If the RGB color value passed to CreateSolidBrush doesn't match an available color, Windows will simulate it using dithering.

squares has a horizontal strip of medium gray running through the center. This is actually the center of the cube stretched out horizontally.

HOW CLRCUBE WORKS

The CLRCUBE program divides each of the eight squares into a 17-by-17 grid of small rectangles. Each small rectangle is associated with a particular RGB color value. For example, the top side of the square at the upper-left corner of the client area runs from black to blue. The red and green values are 0, and the blue values range from 0, 0x10, 0x20, and so forth, up to 0xD0, 0xE0, and 0xFF.

The program uses the *Windows* RGB macro to form an RGB color value for each small rectangle. This RGB color value is passed to the CreateSolidBrush function, which returns a handle to a brush. The brush handle is then passed to the FillRect function to fill the interior of the small rectangle with that brush.

As I've mentioned, if the RGB color value passed to CreateSolidBrush does not match a color available on the display, *Windows* attempts to simulate the color using dithering. Clearly, dithering is at work in the CLRCUBE program. The VGA can display only 16 colors simultaneously,

CLRCUBE.C

1 of 2

```
/*
CLRCUBE.C -- Windows Color Cube
(c) Charles Petzold, 1990
*/

#include <windows.h>
#include "clrcube.h"

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG);
char szAppName [] = "clrcube";

int PASCAL WinMain (HANDLE hInstance, HANDLE hPrevInstance,
LPSTR lpszCmdLine, int nCmdShow)
{
    HWND hwnd;
    MSG msg;
    WNDCLASS wndclass;

    if (!hPrevInstance)
    {
        wndclass.style = CS_HREDRAW | CS_VREDRAW;
        wndclass.lpfnWndProc = WndProc;
        wndclass.cbClsExtra = 0;
        wndclass.cbWndExtra = 0;
        wndclass.hInstance = hInstance;
        wndclass.hIcon = NULL;
        wndclass.hCursor = LoadCursor (NULL, IDC_ARROW);
        wndclass.hbrBackground = GetStockObject (WHITE_BRUSH);
        wndclass.lpszMenuName = szAppName;
        wndclass.lpszClassName = szAppName;

        RegisterClass (&wndclass);
    }

    hwnd = CreateWindow (szAppName, "Color Cube",
        WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT,
        CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL);

    ShowWindow (hwnd, nCmdShow);
    UpdateWindow (hwnd);

    while (GetMessage (&msg, NULL, 0, 0))
    {
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }
    return msg.wParam;
}

void DrawRect (HDC hdc, RECT *pre, COLORREF cr, WORD wType)
{
    HBRUSH hbrush;

    if (wType == IDM_PURE)
    {
        cr = GetNearestColor (hdc, cr);
        hbrush = CreateSolidBrush (cr);
        FillRect (hdc, pre, hbrush);
        DeleteObject (hbrush);
    }

    void DrawColorCube (HDC hdc, short cxClient, short cyClient, WORD wType)
    {
        COLORREF cr;
        LONG x, y;
        RECT rc;

        // UL: Black, UR: Blue, LL: Green, LR: Cyan
        for (y = 0; y <= 16; y++)
            for (x = 0; x <= 16; x++)
            {
                rc.left = (short) (x * cxClient / 60);
                rc.top = (short) (y * cyClient / 51);
                rc.right = (short) ((x + 1) * cxClient / 60);
                rc.bottom = (short) ((y + 1) * cyClient / 51);

                cr = RGB (0, min (255, 16 * y), min (255, 16 * x));

                DrawRect (hdc, &rc, cr, wType);
            }

        // UL: Green, UR: Cyan, LL: Yellow, LR: White
        for (y = 0; y <= 16; y++)
            for (x = 0; x <= 16; x++)
            {
                rc.left = (short) (x * cxClient / 60);
                rc.top = (short) ((y + 17) * cyClient / 51);
                rc.right = (short) ((x + 1) * cxClient / 60);
                rc.bottom = (short) ((y + 18) * cyClient / 51);

                cr = RGB (min (255, 16 * y), 255, min (255, 16 * x));

                DrawRect (hdc, &rc, cr, wType);
            }

        // UL: Yellow, UR: White, LL: Red, LR: Magenta
        for (y = 0; y <= 16; y++)
            for (x = 0; x <= 16; x++)
            {
                rc.left = (short) (x * cxClient / 60);
                rc.top = (short) ((y + 34) * cyClient / 51);
                rc.right = (short) ((x + 1) * cxClient / 60);
                rc.bottom = (short) ((y + 35) * cyClient / 51);

                cr = RGB (255, max (0, 255 - 16 * y), min (255, 16 * x));

                DrawRect (hdc, &rc, cr, wType);
            }

        // UL: Cyan, UR: Blue, LL: White, LR: Magenta
    }
}
```

Figure 2: The CLRCUBE.C file contains all the C source code for the program.

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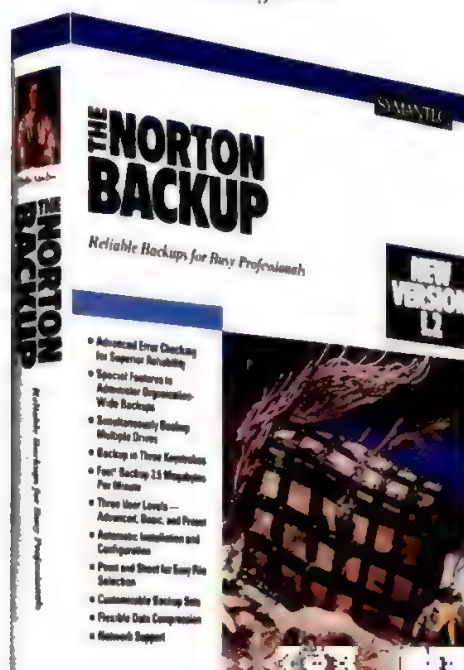
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CIRCLE 179 ON READER SERVICE CARD

Environments

yet CLRCUBE displays what appears to be fairly smooth and continuous ranges of color.

If you run CLRCUBE on your own machine, you can clearly see how dithering works. That horizontal strip at the upper left that progresses from black to blue uses only three pure colors—black, dark blue, and light blue. All the other colors are combinations of these three pure colors in various patterns.

Dithering is clearly a compromise solution for milking more colors out of a limited video adapter such as the VGA. It doesn't work well at all for lines or text characters, and it isn't satisfactory even for filled areas.

The higher the resolution of the video adapter, the better the dithered colors appear on the screen. Well, this statement is not entirely true either. When I run CLRCUBE on my IBM 8514/A video adapter and monitor, the result is so annoying that I can barely stand to look at it. I

normally don't mind the interlacing of scan lines used by the 8514/A, but it becomes brutally obvious when large areas of dithered colors are displayed. The screen seems to pulsate erratically.

Dithering is clearly a compromise solution for milking more colors out of a limited video adapter such as the VGA.

Moreover, dithered colors and the half-tone process used in printing screenshots in this magazine are enemies. Both techniques use color dots, and they can sometimes interfere with each other, causing moiré patterns.

SEEING THE PURE COLORS

CLRCUBE has a single menu item labeled Color. This invokes a submenu with two options, Dithered and Pure. The Dithered option is the default. If you select the Pure option, CLRCUBE creates brushes that use only the pure colors available on the video display. The results are shown in Figure 7.

The image shown in this figure looks a little peculiar, of course, but you can still identify the primary colors at the corners of each square. Figures 6 and 7 clearly demonstrate the differences between dithered and pure colors. In Figure 7, the color of the horizontal strip across the top-left corner jumps abruptly from black to dark blue to light blue.

The function that CLRCUBE uses to obtain the pure color that most closely approximates a desired color is `GetNearestColor`. The syntax of this function is as follows:

```
crPure = GetNearestColor (hdc,
cr) ;
```

The first parameter of the `GetNearest-`

CLRCUBE.C

2 of 2

```
for (y = 0 ; y <= 16 ; y++)
  for (x = 0 ; x <= 16 ; x++)
  {
    rc.left = (short) ((x + 17) * cxClient / 60) ;
    rc.top = (short) ((y + 17) * cyClient / 51) ;
    rc.right = (short) ((x + 18) * cxClient / 60) ;
    rc.bottom = (short) ((y + 18) * cyClient / 51) ;

    cr = RGB (min (255, 16 * y), max (0, 255 - 16 * x), 255) ;

    DrawRect (hdc, &rc, cr, wType) ;
  }

// UL: Blue, UR: Black, LL: Magenta, LR: Red

for (y = 0 ; y <= 16 ; y++)
  for (x = 0 ; x <= 16 ; x++)
  {
    rc.left = (short) ((x + 34) * cxClient / 60) ;
    rc.top = (short) ((y + 17) * cyClient / 51) ;
    rc.right = (short) ((x + 35) * cxClient / 60) ;
    rc.bottom = (short) ((y + 18) * cyClient / 51) ;

    cr = RGB (min (255, 16 * y), 0, max (0, 255 - 16 * x)) ;

    DrawRect (hdc, &rc, cr, wType) ;
  }

// UL: Black, UR: Green, LL: Red, LR: Yellow

for (y = 0 ; y <= 16 ; y++)
  for (x = 0 ; x <= 16 ; x++)
  {
    rc.left = (short) ((x + 51) * cxClient / 60) ;
    rc.top = (short) ((y + 17) * cyClient / 51) ;
    rc.right = (short) ((x + 52) * cxClient / 60) ;
    rc.bottom = (short) ((y + 18) * cyClient / 51) ;

    cr = RGB (min (255, 16 * y), min (255, 16 * x), 0) ;

    DrawRect (hdc, &rc, cr, wType) ;
  }

// UL: Yellow, UR: White, LL: Blue, LR: Black

for (y = 0 ; y <= 16 ; y++)
  for (x = 0 ; x <= 16 ; x++)
  {
    rc.left = (short) ((x + 34) * cxClient / 60) ;
    rc.top = (short) ((y + 17) * cyClient / 51) ;
    rc.right = (short) ((x + 35) * cxClient / 60) ;
    rc.bottom = (short) ((y + 18) * cyClient / 51) ;

    cr = RGB (max (0, 255 - 16 * y), max (0, 255 - 16 * x),
              min (255, 16 * x + 16 * y - 2 * x * y)) ;

    DrawRect (hdc, &rc, cr, wType) ;
  }

// UL: Magenta, UR: Red, LL: Green, LR: Cyan
```

```
for (y = 0 ; y <= 16 ; y++)
  for (x = 0 ; x <= 16 ; x++)
  {
    rc.left = (short) ((x + 34) * cxClient / 60) ;
    rc.top = (short) ((y + 34) * cyClient / 51) ;
    rc.right = (short) ((x + 35) * cxClient / 60) ;
    rc.bottom = (short) ((y + 35) * cyClient / 51) ;

    cr = RGB (max (0, 255 - 16 * y), min (255, 16 * y),
              max (0, 255 - 16 * x - 16 * y + 2 * x * y)) ;

    DrawRect (hdc, &rc, cr, wType) ;
  }

}

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam, LONG lParam)
{
  static short cxClient, cyClient ;
  static WORD wType = IDM_DITHERED ;
  HDC hdc ;
  HMENU hMenu ;
  PAINTSTRUCT ps ;

  switch (message)
  {
    case WM_CREATE:
      hMenu = GetMenu (hwnd) ;

      switch (wParam)
      {
        case IDM_PURE:
        case IDM_DITHERED:
          CheckMenuItem (hMenu, wType, MF_UNCHECKED) ;
          wType = wParam ;
          CheckMenuItem (hMenu, wType, MF_CHECKED) ;

          InvalidateRect (hwnd, NULL, TRUE) ;
          return 0 ;
        }

      break ;

    case WM_SIZE:
      cxClient = LOWORD (lParam) ;
      cyClient = HIWORD (lParam) ;
      return 0 ;

    case WM_PAINT:
      hdc = BeginPaint (hwnd, &ps) ;

      DrawColorCube (hdc, cxClient, cyClient, wType) ;

      EndPaint (hwnd, &ps) ;
      return 0 ;

    case WM_DESTROY:
      PostQuitMessage (0) ;
      return 0 ;
  }

  return DefWindowProc (hwnd, message, wParam, lParam) ;
}
```


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Environments

Color function is the handle to the device context, and the second is a COLORREF value. The function returns a COLORREF value of a pure color that most closely approximates the color that has been specified in the second parameter.

UPWARD TO THE 8514/A

Now let's turn to running CLRCUBE on an IBM 8514/A video adapter and monitor. The 8514/A is capable of 256 simultaneous colors, rather than the 16 the VGA can produce, so we should see something a little different.

Figure 8 shows CLRCUBE running on an 8514/A with the Dithered option

selected. It looks a lot like Figure 6, except that the resolution is higher.

Now let's select the Pure option from the menu. You can see the results in Figure 9, but they're probably not what you expected. Figure 9 looks a lot like Figure 7. The increased color capability of the 8514/A is hardly evident. It almost seems as if the *Windows* device driver for the 8514/A is limiting itself to the same colors that are available on the VGA.

That's just about correct. On the VGA, you get 16 pure colors. On the 8514/A, you get only 20—not 256. How can you access the extra 236 possible colors? That's a job that requires use of the new *Windows* 3.0 palette manager, and I'll discuss it in my next column.

Now I would like to pose an innocent question: What are the RGB values of the

and VGA supported only eight pure colors. (As far as I can determine, this was done for performance reasons. But it made people angry, because they felt they were losing a quarter of the color capability of their video boards.)

At that time, it was easy to guess at the eight available pure colors. They are shown below:

Color	Red	Green	Blue
Black	00	00	00
Blue	00	00	FF
Green	00	FF	00
Cyan	00	FF	FF
Red	FF	00	00
Magenta	FF	00	FF
Yellow	FF	FF	00
White	FF	FF	FF

Ahh, those were the simple days. But times have changed and now *Windows* 3.0 supports 16 colors on the EGA and VGA, and 20 colors (or 256 colors, using the palette manager) on the 8514/A.

COLOR AND DEVICE CAPABILITIES

The first step in exploring the color capability of an output device in *Windows* is the *GetDeviceCaps* (get device capabilities) function. The function has the following general syntax:

```
nValue = GetDeviceCaps (hdc,
                        nIndex) ;
```

The second parameter is a constant identifier defined in the *WINDOWS.H* header file for use with this function. The function returns a value associated with that index.

The table below shows the indexes that pertain to color, and the values that *GetDeviceCaps* returns for each of them for the VGA and 8514/A.

GetDeviceCaps		
Parameter	VGA	8514/A
BITSPIXEL	1	8
PLANES	4	1
NUMCOLORS	16	20
RASTERCAPS,		
RC_PALETTE bit	0	1
SIZEPALETTE	N/A	256
NUMRESERVED	N/A	20
COLORRES	N/A	18

The first two indexes in the table show how memory is organized on the video

CLRCUBE.RC

COMPLETE LISTING

```
/*-----
CLRCUBE.RC resource script
-----*/

#include "clrcube.h"

CLRCUBE MENU
{
    POPUP "&Colors"
    {
        MENUITEM "&Pure",      IDM_PURE
        MENUITEM "&Dithered",  IDM_DITHERED, CHECKED
    }
}
```

Figure 3: The CLRCUBE.RC resource script contains the definition of the program's menu.

CLRCUBE.H

COMPLETE LISTING

```
/*-----
CLRCUBE.H header file
-----*/

#define IDM_PURE      1
#define IDM_DITHERED 2
```

Figure 4: The CLRCUBE.H header file defines constants used in both the source code and the resource script.

pure colors available by default on the VGA and 8514/A?

I think you'll agree that it would be nice if a program could access this information. For example, if a word processing application allows the user to choose a text color, only pure colors should be available, not dithered colors.

A HISTORICAL NOTE

Back in the old days of *Windows* 1.0, 2.0, and 2.1, the standard drivers for the EGA

CLRCUBE.DEF

COMPLETE LISTING

```
/*-----
CLRCUBE.DEF module definition file
-----*/

NAME CLRCUBE

DESCRIPTION 'Windows Color Cube (c) Charles Petzold, 1998'
EXETYPE WINDOWS
STUB 'WINSTUB.EXE'
CODE PRELOAD MOVEABLE DISCARDABLE
DATA PRELOAD MOVEABLE MULTIPLE
HEAPSIZE 1624
STACKSIZE 8192
EXPORTS WndProc
```

Figure 5: CLRCUBE.DEF file is the module-definition file for the program.

Environments

adapter. The VGA has four color planes for its 16 colors, while the 8514/A has 8 consecutive bits per pixel for its 256 colors. This information used to be important for working with bitmaps, but the new device-independent bitmaps in *Windows* 3.0 are less tied to the organization of memory on the video board.

The NUMCOLORS value shows the number of colors available on the device. Note that this value is 20 for the 8514/A, not 256.

If you call `GetDeviceCaps` with the `RASTERCAPS` parameter, you can test the return value using the `RC_PALETTE` identifier. If the `RC_PALETTE` bit is set, then the video adapter supports palette manipulation under *Windows*. The 8514/A does, but the VGA does not.

The next three indexes are valid only when the device supports palette manipulation. These give the total size of the palette (which is finally the 256 value expected for the 8514/A), the number of entries in the palette table that *Windows* reserves for its own purpose such as system colors (this is the value of 20), and the actual color resolution of the device in bits. The color resolution value of 18 for the 8514/A means that the palette table on the video board supports an 18-bit RGB color value—6 bits each for red, green, and blue.

Now we know that the VGA supports 16 pure colors and the 8514/A (without using the palette manager) supports 20 pure colors. But we still don't know what these colors are.

GETTING THE DEVICE COLORS

If this were the OS/2 Graphics Programming Interface (GPI) and we wanted to know the pure colors available on the output device, we could call `GpiQuery-RealColors`. Unfortunately, we're not talking about GPI here. This is the *Windows* GDI, and getting this information is not that easy.

The only foolproof method I've found for obtaining the device colors is to loop through every one of the possible colors and call `GetNearestColor` for each. If `GetNearestColor` happens to return the same color value that was passed to it, then it's a device color.

The only real problem with this technique—and it's a substantial one—is



Figure 6: CLRCUBE with dithered colors running under *Windows* on a VGA display.

Figure 7: CLRCUBE with pure colors running under *Windows* on a VGA display.

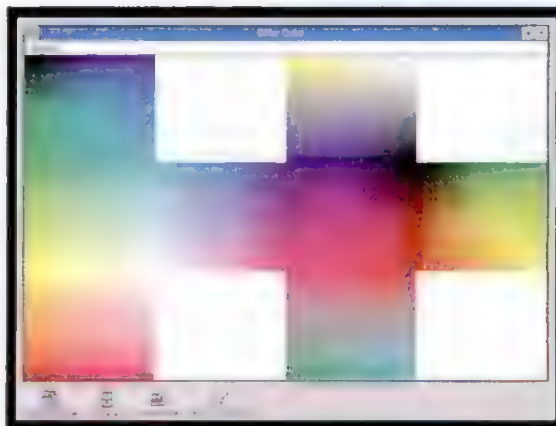
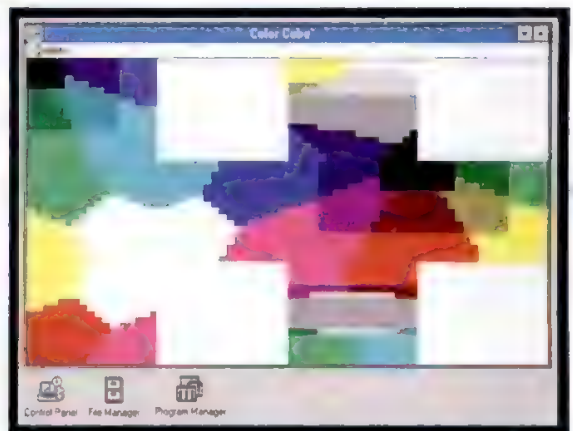
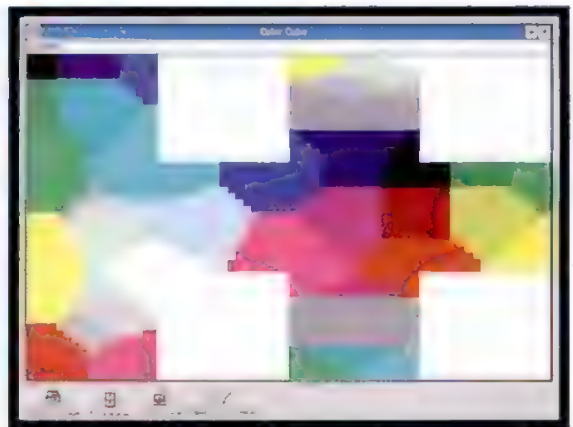


Figure 8: CLRCUBE with dithered colors running under *Windows* on an 8514/A.

Figure 9: CLRCUBE with pure colors running under *Windows* on an 8514/A.



8
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16
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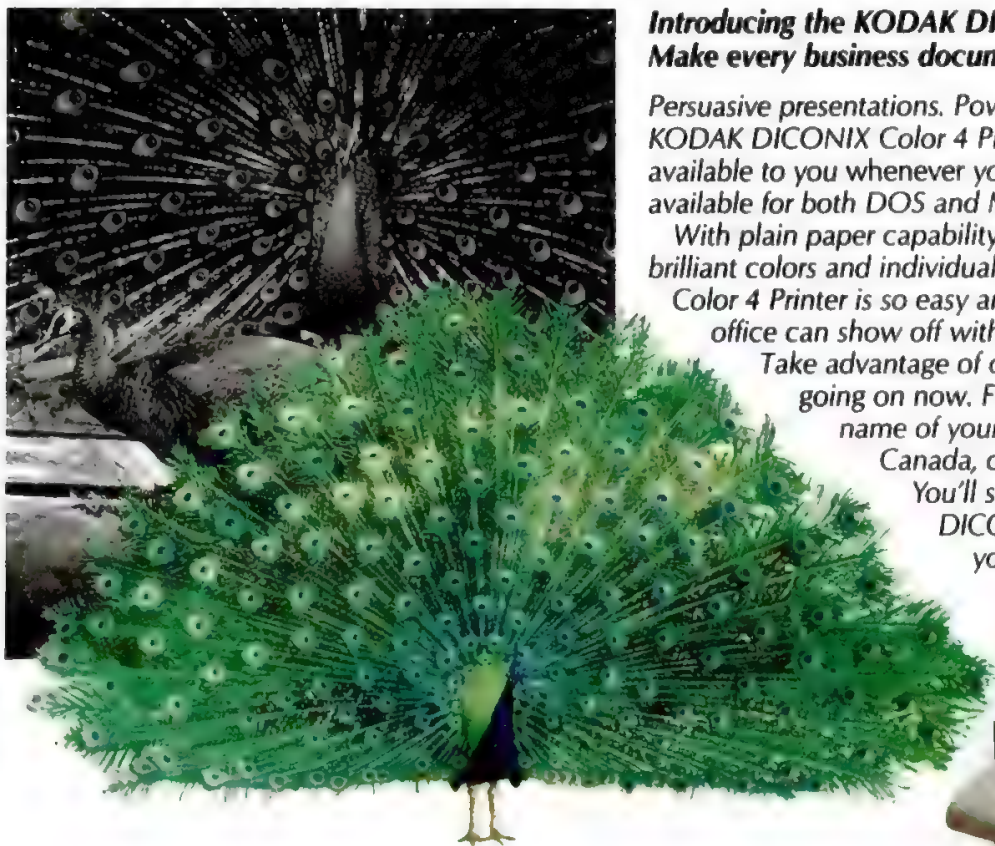
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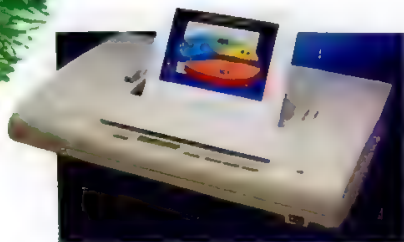
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Environments

performance. The technique requires 16 million calls to GetNearestColor! On my 20-MHz 386 machine with an 8514/A, the job took about an hour.

The following table shows the 16 device

The VGA supports 16 pure colors and the 8514/A has 20, but it isn't easy to find out what they are.

colors available on the VGA in Windows 3.0. These values are not very surprising:

Color	Red	Green	Blue
Black	00	00	00
Dark blue	00	00	80
Dark green	00	80	00
Dark cyan	00	80	80
Dark red	80	00	00
Dark magenta	80	00	80
Brown	80	80	00
Dark gray	80	80	80
Light gray	C0	C0	C0
Light blue	00	00	FF
Light green	00	FF	00
Light cyan	00	FF	FF
Light red	FF	00	00
Light magenta	FF	00	FF
Yellow	FF	FF	00
White	FF	FF	FF

The 8514/A adds four colors to this list. The additional RGB color values are A0-A4, A4-C8-F0, C0-DC-C0, and FF-FB-F0. These seem rather odd, but the first is used by default for the desktop background, and the second for the title bar of the active window.

For a while, I thought that using the Windows Escape function with the GETCOLORTABLE parameter might be the answer to this problem. Although the Escape function is commonly used with printers, some subfunctions are supported by device drivers for video adapters. This worked for the VGA but not for the 8514/A. Maybe

that's a bug, because the Escape function reported that the GETCOLORTABLE subfunction is supported by the 8514/A driver.

The GetSystemPaletteEntries function also looked promising. However, this function didn't work for the VGA. For the 8514/A, the function seemed to return all the RGB values for the 256 palette entries, but there was no indication of which 20 of these RGB values were the

pure colors available by default on the 8514/A.

I guess this means that I am at a loss. If anybody knows of a better way to obtain all the device colors that are available on the 8514/A (and other adapters that support more than 16 colors), leave a message on PC MagNet and let me know about it.

In the next issue, we'll examine the new Windows 3.0 palette manager. ■

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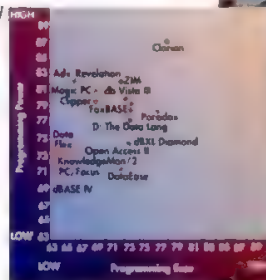
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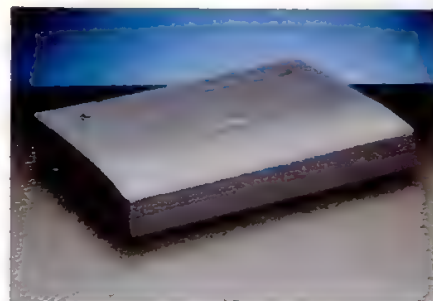
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CIRCLE 187 ON READER SERVICE CARD

by
Ray Duncan

Power Programming

An Introduction to The DOS Protected Mode Interface

I'll never forget how startled I was when I encountered the DOS Protected Mode Interface in its primordial form for the first time. I was sitting in a Microsoft OS/2 2.0 Independent Software Vendor (ISV) seminar in the fall of 1989, with my mind only half-engaged during a talk on OS/2 2.0's Multiple Virtual DOS Machines (MVDMS), when the speaker mentioned in passing that OS/2 2.0 would support a new interface for the execution of DOS extender applications. This casual remark focused my mind remarkably, because at the time I was up to my ears in the production of the Addison-Wesley book *Extending DOS*. The last thing I wanted to hear was that there was an important new protected-mode DOS programming interface that our as-yet-unpublished book would totally neglect.

I asked the speaker for more information, explaining that his mystery interface was about to have a severe impact on a book project near and dear to my heart. In a couple of hours, the Microsoftie returned with a thick document entitled "DOS Protected Mode Interface Specification, Revision Pre-release 0.04"—still warm from the Xerox machine and generously garnished with "CONFIDENTIAL" warning messages. I suspect I made a most amusing spectacle, as I flipped through the pages with my eyes popping and my jaw dropping to the floor. The document I had been handed was nothing more or less than the functional specification of a protected-mode version of DOS!

In retrospect, the fact that Microsoft was cooking up something like the DPMS should have been obvious. Every computer journalist in America, as well as thousands of beta testers, was well aware that the as-yet-unannounced *Microsoft Windows 3.0* was somehow able to take advantage of extended memory by executing applications in protected mode, even though it ran on top of DOS and used the DOS file system. It was even fairly widely known that you could use a utility program to "mark" the .EXE file headers of

■ The DPMS had its origins in the *Windows 3.0* development project, but the industry standard DPMS as we know it today only vaguely resembles Microsoft's original internal specification.

old (that is, *Windows 2.03*) applications, and that many such programs would then run (at least for a while) in protected mode, even though they hadn't been recompiled or relinked. But I never saw a word of speculation in print on how this was done, and I never gave it a second thought; I was much too preoccupied with the shifting sands of OS/2 to spend any time puzzling over the internals of a forthcoming version of *Windows*.

How does *Windows 3.0* work its magic? The answer is simple: *Windows 3.0* has a built-in DOS extender! When an application is running in protected mode, *Windows* traps the application's requests for DOS and ROM BIOS services by intercepting its execution of software interrupts (INT instructions). *Windows* then performs any virtual-to-physical address conversions that may be required, copies data from extended memory into conventional memory if necessary, switches the CPU into real mode, and re-issues the function call. When control returns from DOS or the ROM BIOS, *Windows* switches the CPU back into protected mode, converts addresses from physical to virtual

and copies data from conventional memory to extended memory as appropriate, and finally hands the machine back to the application.

The process I've just described is perfectly standard DOS extender technology (see my columns in the September 26, October 17, and October 31, 1989, issues of *PC Magazine*), except that these facilities are available to every program running under *Windows 3.0* on an 80286, 80386, or 80486 CPU.

The implications are immense. It would be a trivial exercise for Microsoft to subsume the *Windows 3.0* DOS extender into DOS itself, thereby creating an operating system with identical APIs in both real and protected mode. The market for third-party DOS extenders would vanish, the tortuous pathway to protected mode for MS-DOS ISVs would turn into a freeway, the evolution of DOS into a 32-bit, 386-based operating system would become inevitable, and DOS's lifespan would be prolonged nearly indefinitely.

I find it ironic that Microsoft, while it preached the advantages of OS/2's totally new API and bad-mouthed DOS extenders for the last three years, was actually preparing to legitimize DOS extender technology on a massive scale.

THE POLITICS OF PROTECTED MODE

Although the DPMS had its origins in the *Windows 3.0* development project, and *Windows 3.0* is the only commercially available DPMS server as this column is written, the industry DPMS standard as we know it today only vaguely resembles that original internal Microsoft specifica-

Power Programming

tion I saw so long ago. Microsoft originally defined the DPMI in two layers: a set of low-level functions for interrupt management, mode switching, and extended memory management, and a higher-level interface that provided access to MS-DOS, ROM BIOS, and mouse driver functionality via protected-mode execution of INT 21h, INT 10h, INT 33h, and so on. The higher-level DPMI functions were implemented in terms of the low-level DPMI functions and the extant real-mode DOS and ROM BIOS interface.

When details of Microsoft's DPMI began to leak out to the general community of MS-DOS developers, the rumors provoked more than a few hard feelings and harsh words, for two very good reasons: First, the vendors of other DOS extenders suspected that Microsoft, having realized that OS/2 wasn't going to replace DOS any time soon, had decided to barge into the market niche they had established so painfully and elbow them out through the sheer weight of its development resources and marketing power. Second, Microsoft had designed the DPMI with total disregard for compatibility with the existing industry standard for DOS-based protected-mode software—the Virtual Control Program Interface (VCPI).

VCPI was developed in 1987 by Phar Lap Software and Quarterdeck Office Systems with a fairly narrow objective: to allow 80386 protected-mode DOS extender applications to coexist with 80386-specific memory managers and expanded memory (EMS) emulators such as Qualitas's *386-to-the-Max* and Quarterdeck Office Systems's *QEMM-386*. In spite of (or because of) its limited goals, the VCPI was quite successful. It became an accepted industry standard in April 1989, and by 1990 virtually every 80386-specific software product on the market supported or was capable of using the VCPI interface—except for Microsoft's products.

The VCPI assumes a client-server model, where the DOS extender application is the client and the EMS emulator is the server. The client invokes the server via an extension of the Lotus/Intel/Microsoft Expanded Memory Specification (EMS) INT 67h interface to switch between real and protected modes, allocate memory, program the interrupt controller(s), and inspect or set the 80386 debug registers.

Function number	Function name	DPMI 09	DPMI 10
LDT Management Services			
0000h	Allocate LDT Descriptor	*	*
0001h	Free LDT Descriptor	*	*
0002h	Map Real Mode Segment to Descriptor	*	*
0003h	Get Next Selector Increment Value	*	*
0004h	Reserved		
0005h	Reserved		
0006h	Get Segment Base Address	*	*
0007h	Set Segment Base Address	*	*
0008h	Set Segment Limit	*	*
0009h	Set Descriptor Access Rights	*	*
000Ah	Create Code Segment Alias Descriptor	*	*
000Bh	Get Descriptor	*	*
000Ch	Set Descriptor	*	*
000Dh	Allocate Specific LDT Descriptor	*	*
000Eh	Get Multiple Descriptors		*
000Fh	Set Multiple Descriptors		*
DOS Memory Management Services			
0100h	Allocate DOS Memory Block	*	*
0101h	Free DOS Memory Block	*	*
0102h	Resize DOS Memory Block	*	*
Extended Memory Management Services			
0500h	Get Free Memory Information	*	*
0501h	Allocate Memory Block	*	*
0502h	Free Memory Block	*	*
0503h	Resize Memory Block	*	*
0504h	Allocate Linear Memory Block	*	*
0505h	Resize Linear Memory Block	*	*
0506h	Get Page Attributes	*	*
0507h	Modify Page Attributes	*	*
0508h	Map Device in Memory Block	*	*
0509h	Map Conventional Memory in Memory Block	*	*
050Ah	Get Size of Memory Block	*	*
0800h	Physical Address Mapping	*	*
0801h	Free Physical Address Mapping	*	*
0D00h	Allocate Shared Memory	*	*
0D01h	Free Shared Memory	*	*
0D02h	Serialize on Shared Memory	*	*
0D03h	Free Serialization on Shared Memory	*	*
Page Management Services			
0600h	Lock Linear Region	*	*
0601h	Unlock Linear Region	*	*
0602h	Mark Real Mode Region as Pageable	*	*
0603h	Relock Real Mode Region	*	*
0604h	Get Page Size	*	*

CONTINUES

Figure 1: These are the function numbers and names of the DPMI services. The grouping shown here is my own; it is not the same as the grouping found in the DPMI Specification.

If a DOS extender application is loaded and no VCPI server is present, the DOS extender assumes total control of the machine and carries out these hardware-dependent manipulations directly. A more detailed description of the VCPI can be found in Bob Moote's excellent chapter in *Extending DOS* (Addison-Wesley, Reading, Massachusetts, 1990).

In the context of the problems it was designed to solve, the VCPI works extremely well, but it is an inadequate plat-

form for the *multitasking* of DOS extender applications. The VCPI allows client programs to run at the highest privilege level (Ring 0). This makes it impossible for a VCPI server to enforce *device virtualization* (for example, running graphic applications in a window), provide centralized virtual memory management services, or shield one DOS extender application from interference from another. Another, somewhat less important drawback of the VCPI is that it is funda-

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Power Programming

mentally based on the concept of 80386 hardware paging and therefore can't be implemented on 80286 machines.

The creators of the VCPI were well aware of its limitations and were already hard at work on a second generation specification called *Extended VCPI* (XVCPI), when Microsoft barged onto the scene with the beta-test versions of *Windows 3.0* and its DPMI. For a few months, it appeared that the fledgling DOS extender market would fragment into two mutually exclusive directions, resulting in additional headaches for software developers, hassles for end users, and juicy fees for lawyers. Luckily, cooler heads prevailed. Microsoft turned control of the DPMI specification over to an industry committee with open membership, and the backers of the XVCPI effort decided to join forces behind the DPMI. Intel, with its understandable enthusiasm for anything that might sell more 80386 chips, was instrumental in bringing about this reconciliation and also took on the responsibility of publishing and distributing the DPMI Specification.

As part of this accommodation, Microsoft agreed to delete the portions of the DPMI that crossed into DOS extender territory—specifically, direct support of the DOS and ROM BIOS interrupts in protected mode. Consequently, DPMI, Version 0.9, the first public version, released by the DPMI Committee in May 1990, defines only the low-level or building-block functions I mentioned earlier. The additional functions in DPMI, Version 1.0, announced in November 1990, are also relatively low-level and are aimed at specific issues of 386-specific memory management and memory sharing (see Figure 1). Naturally, the higher-level or DOS extender interface of *Windows 3.0* still exists, but it has receded into the twilight zone of undocumented functionality. Undocumented, but hardly unusable—as we shall see.

Although the circumstances of DPMI's birth were somewhat stormy, I think it's fair to say that everyone involved now agrees that the DPMI is a sizable improvement over the VCPI. In many respects, a DPMI server program is similar to a VCPI server, in that it provides mode switching and extended memory management services to client programs. But

THE DPMI SERVICES			
Function number	Function name	DPMI 0.9	DPMI 1.0
Page Management Services (continued)			
0700h	Reserved		
0701h	Reserved		
0702h	Mark Page as Demand Paging Candidate	*	*
0703h	Discard Page Contents	*	*
Interrupt Management Services			
0200h	Get Real Mode Interrupt Vector	*	*
0201h	Set Real Mode Interrupt Vector	*	*
0202h	Get Processor Exception Handler Vector	*	*
0203h	Set Processor Exception Handler Vector	*	*
0204h	Get Protected Mode Interrupt Vector	*	*
0205h	Set Protected Mode Interrupt Vector	*	*
0210h	Get Extended Processor Exception Handler Vector in Protected Mode		*
0211h	Get Extended Processor Exception Handler Vector in Real Mode		*
0212h	Set Extended Processor Exception Handler Vector in Protected Mode		*
0213h	Set Extended Processor Exception Handler Vector in Real Mode		*
0900h	Get and Disable Virtual Interrupt State	*	*
0901h	Get and Enable Virtual Interrupt State	*	*
0902h	Get Virtual Interrupt State	*	*
Translation Services			
0300h	Simulate Real Mode Interrupt	*	*
0301h	Call Real Mode Procedure with Far Return Frame	*	*
0302h	Call Real Mode Procedure with Interrupt Return Frame	*	*
0303h	Allocate Real Mode Call-Back Address	*	*
0304h	Free Real Mode Call-Back Address	*	*
0305h	Get State Save Addresses	*	*
0306h	Get Raw CPU Mode Switch Addresses	*	*
Miscellaneous Services			
0400h	Get DPMI Version	*	*
0401h	Get DPMI Capabilities	*	*
0A00h	Get Vendor-Specific API Entry Point	*	*
0B00h	Set Debug Watchpoint	*	*
0B01h	Clear Debug Watchpoint	*	*
0B02h	Get State of Debug Watchpoint	*	*
0B03h	Reset Debug Watchpoint	*	*
0C00h	Install Resident Handler Initialization Call-Back		*
0C01h	Terminate and Stay Resident		*
0E00h	Get Coprocessor Status		*
0E01h	Set Emulation		*

ENDS

unlike a VCPI server, a DPMI server runs (or can run) at a higher privilege level than its clients—using the hardware to enforce a “kernel/user” protection model. This allows a DPMI server to support demand-paged virtual memory and maintain full control over client programs' address spaces and access to the hardware. Furthermore, the DPMI's functions for memory and interrupt management are far more general than those in the VCPI, so the DPMI can also be imple-

mented on 80286 machines.

Over the long run, existence of the DPMI will simplify life enormously for vendors of DOS extenders, multitasking control programs, EMS emulators, and protected-mode programming tools. During the transition, however, the developers of DOS extenders in particular are going to find their life considerably more complicated. Not only will each DOS extender have to be capable of performing all hardware-dependent management func-

Power Programming

tions on its own, but it will have to be able to coexist peacefully with Microsoft's XMS driver (HIMEM.SYS), VCPI servers such as QEMM 5.0, and DPMI servers such as Windows 3.0—a goal similar to writing a single graphic application that could execute equally well under Digital Research's GEM, Microsoft Windows, OS/2's Presentation Manager, or even without an operating system!

THE DPMI INTERFACE

The DOS Protected Mode Interface (DPMI) Specification can be obtained at no charge from Intel Literature Sales, P.O. Box 58130, Santa Clara, CA 95052, or telephone 800-548-4725. The function calls supported by the DPMI fall into seven general categories, as shown in Figure 1:

- The *LDT Management* functions allow a program to manipulate its Local Descriptor Table (LDT). A program can allocate and free descriptors (and their associated selectors), inspect or modify the descriptors, map real-mode addresses onto protected-mode selectors, change the access rights of a segment (for example, from read-write to read-only), and obtain a read/write data selector (alias) for an executable selector.

- The *DOS Memory Management* functions provide a protected-mode interface to the real-mode MS-DOS INT 21h Functions 48h (Allocate Memory Block), 49h (Free Memory Block), and 4Ah (Resize Memory Block). Using these functions, a protected-mode program can obtain memory below the 640K limit that it can use to exchange data with MS-DOS itself, TSRs, ROM BIOS device drivers, and other real-mode programs.

- The *Extended Memory Management* functions are used to allocate, resize, and release blocks of physical memory above the 1MB boundary. The functions are low-level in that they do not allocate selectors or build descriptors for the extended memory blocks; the program must allocate selectors and map the memory onto the selectors with additional DPMI calls. On an 80386 or 80486 with paging enabled, the allocated blocks are always a multiple of 4K. Named shared memory blocks with serialized access are also supported.

- The *Page Management* functions allow memory to be locked or unlocked for swapping on a page-by-page basis in terms

HELLOPMW.C
COMPLETE LISTING



```

/*
HELLOPMW.C --- "Hello Protected Mode World!"
illustrates use of the DPMI interface to switch into
protected mode, and use of Windows 3's built-in DOS
Extender to print a message in protected mode.

Compile in SMALL MODEL with: CL HELLOPMW.C

Execute under Windows 3.0 only:
*/

#include <stdio.h>

unsigned modeswitch();

main()
{
    unsigned saveCS, saveDS;

    _asm mov saveCS,cs          ; store real mode CS
    _asm mov saveDS,ds          ; and DS for display

    printf("\nHello, real mode world! \tCS=%04xh DS=%04xh",
        saveCS, saveDS);

    if(modeswitch())            // attempt mode switch
    {
        puts("\nDPMI not available or memory allocation failed.");
        exit(1);
    }

    _asm mov saveCS,cs          ; store protected mode CS
    _asm mov saveDS,ds          ; and DS for display

    printf("\nHello, protected mode world! \tCS=%04xh DS=%04xh\n",
        saveCS, saveDS);

    _asm mov ah,4ch              ; exit directly to DOS to avoid
    _asm int 21h                 ; GP fault in RTL cleanup code
}

/*
Call DPMI to switch from real mode to protected mode.
Returns false if mode switch successful; true if no DPMI
present or if memory allocation for DPMI data area failed.
*/
unsigned modeswitch(void)
{
    void far *switchpoint;      // far pointer to DPMI
                                // mode switch entry point

    _asm
    {
        mov     ax,1687h        ; get DPMI mode switch
        int     2fh             ; entry point...
        or      ax,ax           ; bail out if no DPMI
        jnz     exitlabel
        mov     word ptr switchpoint,di ; save entry point
        mov     word ptr switchpoint+2,es ; allocate DPMI private
        mov     bx,si           ; data area
        mov     ah,4bh          ;
        int     21h             ;
        jc      exitlabel       ; jump, allocation failed
        mov     es,ax           ; pass segment of data area
        mov     ax,0            ; indicate we are 16-bit app
        call    switchpoint     ; switch to protected mode
        mov     ax,0            ; signal success
    }

    exitlabel: ;                // any "no return value" warning
                                // message here can be ignored
}

```

Figure 2: Here's the source listing for HELLOPMW.C, a Microsoft C program that uses the DPMI to switch into protected mode and then uses the built-in Windows 3.0 DOS extender to display text in protected mode.

of the memory's linear address. There are also functions to query the page size supported by the host CPU and to tune the system's behavior by marking pages for discard or immediate replacement. These functions are only relevant when the host machine is an 80386 or 80486.

- The *Interrupt Management* functions support interception of software or hardware interrupts that occur in real mode or protected mode, installation of handlers for processor exceptions and faults (such

as divide by zero and overflow), and maintenance of a separate "virtual interrupt flag" for each active process.

- The *Translation Services* provide a mechanism for cross-mode procedure calling. They allow a protected-mode program to transfer control to a real-mode routine by either a simulated far call or a simulated interrupt, and pass parameters by value or by reference. A protected-mode program can also declare an entry point (known as a Real Mode Call-Back)

Power Programming

which can be invoked by a real-mode program with an implied mode switch.

■ The *Miscellaneous Services* include address conversions, coprocessor management, debugging support, and a function to get the DPMI version number.

Nearly all of these DPMI functions are intended only for DOS extenders; they would ordinarily never be called directly by an application program. But there are two DPMI functions that we can put to immediate good use: one that indicates whether a DPMI server is present, and one that switches from real to protected mode. These functions allow us to write programs (using ordinary DOS programming tools) that run in protected mode on top of *Windows 3.0's* built-in DOS extender.

First, we need to check for the existence of the DPMI host by executing an INT 2Fh with the value 1687h in AX. If no DPMI server is present, AX is returned unchanged or with some nonzero value. If a DPMI server is available, the

following values are returned:

AX = 0
BX = Flags (bit 0 = 1 if
32-bit programs supported)
CL = Processor type
(02H=80286, 03H=80386,
04H=80486, 05H=80586)
DE = DPMI major version number
DL = DPMI minor version number
SI = number of paragraphs
required for DOS Extender
private data (may be 0)
ES:DI = DPMI mode switch entry
point

Next, we call the entry point whose address was returned in ES:DI to switch the CPU from real mode or Virtual 86 mode into protected mode. Bit 0 of AX is 0 if our program is a 16-bit application, and it's 1 if the application is 32-bit; the remaining bits in AX are reserved. ES must point to the base of a scratch area as large as the size returned in SI from the DPMI existence call. Upon return, the CPU is in protected mode; CS, DS, and SS have been loaded with valid selectors for 64K segments that map to the same physical

memory as the original real-mode values in CS, DS, and SS; ES contains a selector that points to the program's PSP with a 256-byte segment limit; FS and GS contain zero (the null selector) if the host machine is an 80386 or 80486; and all other registers are preserved.

Figure 2 contains a simple C program that illustrates the use of these two calls, as well as *Windows 3.0's* support for INT 21h calls in protected mode. You can use the ordinary Microsoft C Compiler and Linker to build this program, though you must be sure to compile it in the Small Memory Model. You need *Windows 3.0* running on an 80286, 80386, or 80486 to run the program. My thanks to Andrew Schulman for pointing out that such programs are possible! In the next issue, we'll discuss the DPMI and the *Windows 3.0* DOS extender in more detail.

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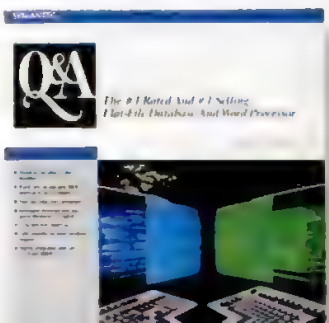
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by
William S. Hall

Windows

MEMORY, MEMORY, EVERYWHERE

I have a 286 machine with 4MB of memory. Most of my *Windows* applications were written for Version 2.x, so I run the environment in real mode. Understanding that real mode can use expanded memory, I've allocated 2MB on the board to expanded; the rest is configured as extended memory used mainly to support SmartDrive and RAMdrive. After loading several *Windows* programs, I run out of memory. What confuses me is that the About box on the Program Manager's Help menu shows nearly 1.6MB of expanded memory remaining. What can I do to utilize this memory?

Craig Stinson

Vancouver, British Columbia, Canada



It appears that you are using small-frame expanded memory (EMS). To verify this, check the About box or confirm that the line

`device=emm386.sys 2048`

comes after `device=himem.sys` in your CONFIG.SYS file.

To make use of more memory, you must implement large-frame EMS. This procedure will vary, depending on your PC and the memory board. I can only give general guidelines.

First, verify (via the documentation or with the manufacturer) that your expanded memory driver supports the LIM (Lotus-Intel-Microsoft) 4.0 specification. Next, make sure that the board can be used to backfill conventional memory down to 256K of memory. Finally, make sure that your computer will allow you to disable all but 256K of conventional memory. If you can meet these three conditions, then follow the instructions in your memory-board documentation to backfill.

Perhaps the term *backfill* is new to you. It refers to disabling some of the memory on the motherboard and replacing it with memory on your EMS board.

Most EMS boards allow you to fill the

■ **MEMORY, MEMORY, EVERYWHERE:** Switch from small-frame to large-frame EMS and get more mileage out of expanded memory.

■ **THE PROPER PRINTER FONT:** How to make sure that *Windows* is selecting the fonts that best match your printer.

gap between 512K and 640K. But to implement large-frame EMS, your board should be able to fill in from 256K to

640K. When used in an AT-compatible machine, an AST RAMpage board will permit such a configuration.

If your board's instructions don't mention backfilling or LIM 4.0 support, call the manufacturer. Many may have added drivers to support the 4.0 specification since you purchased your board. While you have them on the phone, ask if the board can be used to backfill main EMS memory and use large-frame EMS: Sometimes the board supports 4.0 in software but doesn't have the hardware register support for large-frame operation.

By backfilling, you do not lose conventional memory, but you *do* increase the amount of expanded memory that can be allocated to each *Windows* program. With small-frame EMS, the extra memory gained by each program is just the

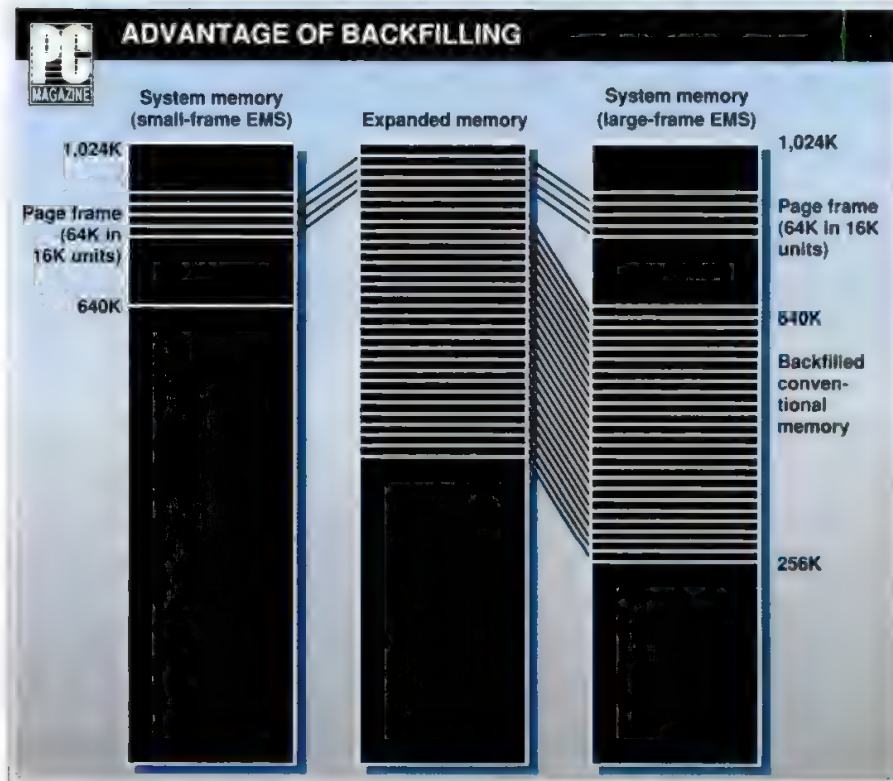


Figure 1: With small-frame EMS, an application uses only one 64K page frame. With large-frame, each has the 64K page frame plus 384K in backfilled conventional memory.

Windows

EMS frame segment—usually a 64K segment where you normally have no actual memory. While each program you load gets this extra bit of memory, most of the program ends up in main memory. After you've run, say, half a dozen substantial programs, main memory is exhausted, but you *still* have quite a lot of expanded memory left that cannot help you.

If you have backfilled, however, a considerable portion of conventional memory is now available exclusively for each new *Windows* program you run. Figure 1 compares the amount of memory available for a *Windows* program when you use small-frame and large-frame EMS.

For example, suppose *Windows* loads and uses 340K of memory. You then have 300K of conventional memory (640K-340K = 300K) plus the page-frame

segment to load programs. But because all of this memory is actually EMS memory, it can be switched out after a *Windows* program has loaded, to make room for the next one. (The switching is actually done by hardware rather than by swapping, so it's quite fast.)

The next program to load also thinks that only *slightly* less than 300K (say, 280K) and the page frame are available. The Program Manager About boxes in Figure 2 illustrate *Windows*' use of memory when small-frame (left) and large-frame (right) EMS are implemented. Thus, you can use EMS memory much more efficiently, because a larger portion of each program can load into EMS memory than is possible under small-frame operation. Now, when you begin to run low on memory, you will find that most of your EMS memory has been used up for programs and you will not experience the frustration of being out of memory while still having a large reserve of EMS free.

THE PROPER PRINTER FONT

I ran into a problem when printing a *Windows Write* document in landscape mode. I was using an Epson 2500/2550 driver to emulate a Panasonic KX-P1124. I found that in comparison with the screen image, the printed text came out at about 1/2 to 2/3 the size I thought it should be.

The solution I *stumbled* across seemed simple. I brought up the Print Setup dialog box and changed the printer graphics resolution from 180 by 180 to 360 by 180. Could you tell me what I actually did?

Bob La Pierre
Great Bend, Kansas



Windows Write is a graphical word processor and the Panasonic is a dot-matrix printer capable of using either its own built-in fonts or those supplied by *Windows*. Normally a *Write* user elects to use one of the *Windows* proportional fonts, like Helvetica or Times Roman, and bypass the printer fonts. The resulting printed output is actually a graphics image of the text. *Windows* has created this image in CPU memory using fonts that best match the printer's characteristics. Hence, the way a document appears in print depends on printer resolution, the fonts available, and how the document is formatted. When Mr. La Pierre altered the printer settings, he no doubt found the right combination of font and resolution to get a satisfactory result.

The *Windows* typographics fonts are classified by letter (A, B, C, D and so on). The class of fonts that works best for your printer will depend not only on the printer's resolution, but on the print mode, (landscape or portrait, for example), the device aspect ratio of the font, and that of the printer. You may want to check the *Windows* fonts you have installed and see if they match the characteristics of your printer. If you installed the printer at the same time you set up *Windows*, then *Windows* will have selected the proper printer fonts for you. However, some machines, such as the Panasonic KX-P1124, are not in the list of supported printers in SETUP.INF. If you add your printer after *Windows* is up and running, the environment may not add the proper fonts.

At a resolution of 180 by 180, a printer such as the KX-P1124 has a device aspect ratio of unity ($180/180 = 1$). If by chance your *Windows* installation did not add fonts meeting this parameter, then "unexpected results" (the very words of the *Windows* programming guide) can occur.

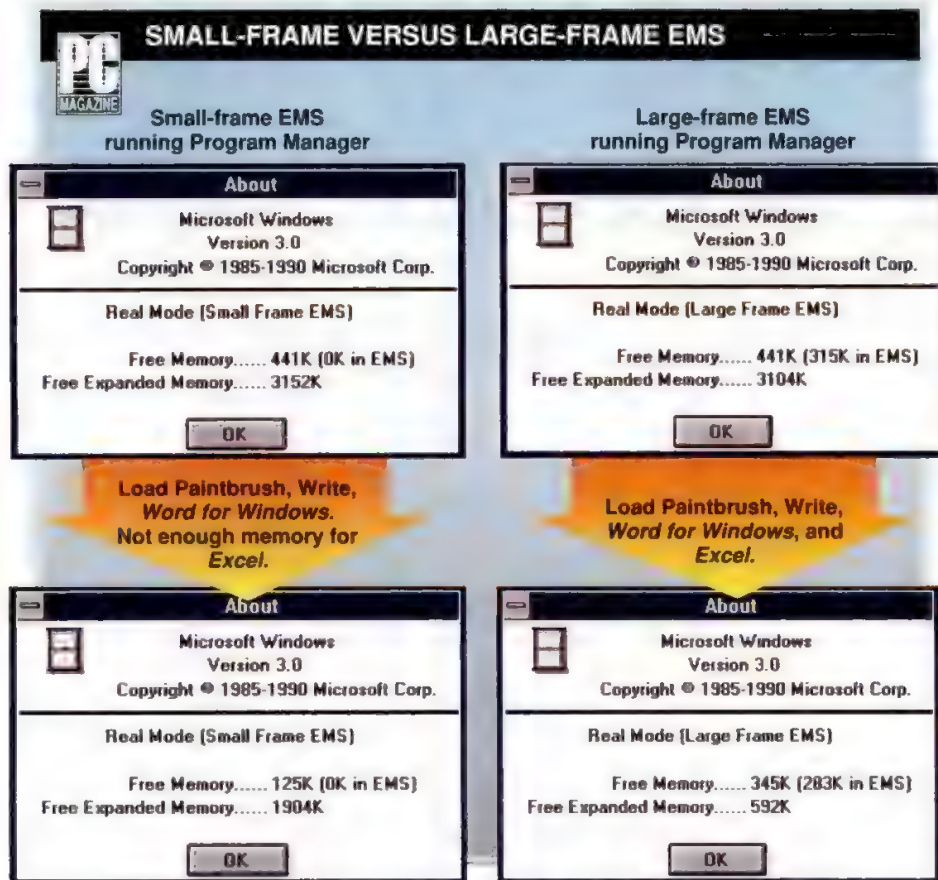


Figure 2: The top two About boxes show the amount of small-frame (left) and large-frame (right) EMS needed to run only the Program Manager. The overhead of backfilling leaves you with slightly less large-frame EMS to start, but *Windows* relies heavily on expanded memory to run the four applications. With small-frame EMS installed, *Windows* uses much less expanded memory and could not even run the fourth program, *Excel*.

Windows

For instance, *Windows* could create a synthesized font that might not look very good or perform as expected.

In this case, you should check not only for the proper resolution, but also for a similar one. You could see if *Windows* has installed the E fonts (TMSRE.FON, COURE.FON, SYMBOLE.FON, and HELVE.FON). Although digitized for the VGA's logical resolution of 96 by 96, these fonts do have the desired aspect ratio of 1 (96/96). These fonts are normally used with the Epson 24-pin printer driver, which the Panasonic printer can emulate.

To see whether *Windows* has added the E fonts, bring up the Fonts dialog box on the Control Panel and scan through the list of installed fonts. Look for entries with *VGA res* in parentheses. If there aren't any, use the control panel to add them. Get disk 4 of your *Windows* distribution disks and place it in one of the floppy disk drives. In the same Fonts dialog box, click on Add and select the drive where

you inserted the diskette. Pick the fonts you need from the list—you can select several at once—and press OK.

The after-the-fact installation of an Epson 9-pin printer illustrates another situation where the correct fonts might not be present. This device prints output from a graphics word processor most satisfactorily in portrait mode if the corresponding D fonts (TMSRD.FON, and so on) are available; D fonts are designed for a resolution of 120 by 72. Similarly, landscape mode works best with the C fonts, which are designed for a resolution of 60 by 72. If you use the Control Panel to install the printer after *Windows* is already running, you will have to add the necessary fonts yourself as described above.

It is not easy to guess the best fonts for a given printer without studying the printer and font entries in SETUP.INF, which you can find in your *Windows* system directory. It's much easier just to install them all. This position of safety, however, will cost you 224 bytes of memory per font, plus extra disk space.

Mr. La Pierre's discovery shows how useful it can be to explore various possibilities to get the desired results. Although

it seems that he has solved his immediate problem by changing the resolution used for landscape printing, he may also want to create some fonts that match the printer more closely. For some time, both Bitstream (*Fontware 3.0*) and Hewlett-Packard (*Type Director*) have been featuring some starter kits for *Windows* at prices in the \$25 to \$40 range. Each supplies two basic font types—one similar to Times Roman and a second similar to Helvetica. Both support the Epson 24-pin printer family in 180-by-180 resolution. Unfortunately, neither provides explicit support for landscape mode. Nevertheless, these products can give you a greater choice of fonts and thus increase the variety of printing possibilities. For more information, contact Bitstream at 800-522-3668, or Hewlett-Packard at 800-752-0900.

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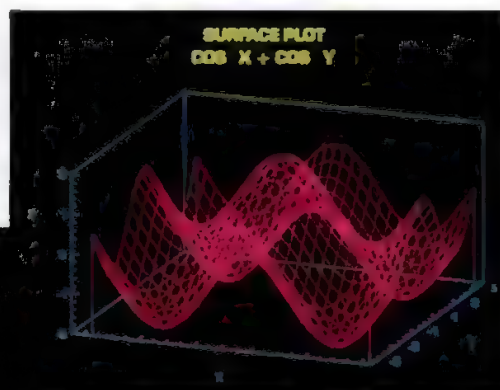
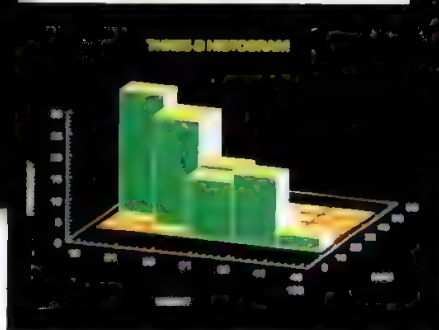
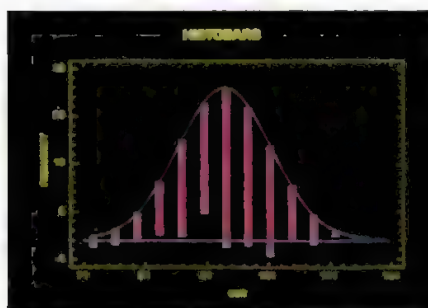
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Databases

STRIPPING COMMAS FROM A NUMERIC STRING

I recently needed to replace a numeric field in *FoxPro* with the contents of a numeric string. Usually, the `VAL()` function can handle this. However, this time the numeric string contained commas, and the `VAL()` function stopped translating when it reached the first comma.

I needed a way to strip the commas from the character field. Searching the *FoxPro* manual, I happened upon the `STRTRAN()` function. The `STRTRAN()` function searches one character string for occurrences of another character string, and replaces them with a third character string.

My solution was to apply the `STRTRAN()` function to my string to remove the commas. Once the commas were stripped, I used the `VAL()` command to convert the string to a numeric field.

Tom Humbarger
Hermosa Beach, California



This is an easy way to remove commas from a formatted numeric string. The `STRTRAN` function processes a string and replaces occurrences of a specified character expression with another specified character expression. By specifying a comma as the value to replace, and by not specifying a value to

■ **STRIPPING COMMAS FROM A NUMERIC STRING:** *FoxPro's* `STRTRAN()` function provides a handy way to remove commas from a string.

■ **VALIDATING DATE STRINGS:** A simple IF routine will make sure that *dBASE III Plus* returns the proper date for a `CTOD()` function.

■ **USING THE RIGHT MOUSE BUTTON:** *FoxPro's* `ON KEY LABEL` command lets you use the mouse—and the keyboard—more efficiently.

replace it with, you can strip commas from the string.

FoxPro's documentation is a little misleading in its discussion of the `STRTRAN` function. It says that if you don't specify a replacement value, characters are replaced

with the null string. But what it really does if no replacement value is specified is simply remove the characters from the string and combine the remaining pieces.

Readers may be interested to note that *Clipper* also has a `STRTRAN` function.

If your *dBASE* implementation doesn't support `STRTRAN`, here is an alternate way that you can use to remove commas from a string:

```
.
. Procedure to remove commas from
. a string
.
PROCEDURE RMCOMMA
PARAMETERS string
X = AT(',',string)
DO WHILE (X <> 0)
    string = SUBSTR(string,1,x-1)+;
        SUBSTR(string,x+1)
    X = AT(',',string)
ENDDO
RETURN
```

You use `RMCOMMA` as follows:

```
. testvar = '123,456,789'
. DO RMCOMMA WITH testvar
. ? testvar
123456789
```

What if you want to remove something besides a comma? Here's a more general routine that accepts the character to remove as a parameter:

```
.
. Procedure to remove all
. instances of a character from a
. string
.
PROCEDURE RMCHAR
PARAMETERS string, rmchar
X = AT(rmchar,string)
DO WHILE (X <> 0)
    string = SUBSTR(string,1,x-1)+;
        SUBSTR(string,x+1)
    X = AT(rmchar,string)
ENDDO
RETURN
```

MAKENUM PROCEDURE

COMPLETE LISTING

- Procedure to strip all non-numeric characters
- from a string. Note, if string has a minus
- sign, it too will be stripped.

```
PROCEDURE MAKENUM
PARAMETERS string
PRIVATE nums, newstring, x, slen
nums="0123456789"
newstring=""
x = 1
slen = LEN(string)
DO WHILE x <= slen
    IF AT(SUBSTR(string,x,1),nums) <> 0
        newstring = newstring + SUBSTR(string,x,1)
    ENDIF
    x = x + 1
ENDDO
string = newstring
RETURN
```



Figure 1: This procedure will remove all nonnumeric characters from a numeric string.

Databases

You use RMCHAR like this:

```
. testvar = '10:20:20'
. DO RMCHAR WITH testvar, ':'
. ? testvar
102020
```

Let's suppose that you'd like to use a single function to strip all nonnumeric characters from a numeric string. The MAKE-
NUM procedure in Figure 1 is one way to do this. It accepts one parameter, the string to strip. You can use it like this:

```
. testvar = '1-(800)999-1234'
. DO MAKENUM WITH testvar
. ? testvar
18009991234
```

This procedure will remove commas from a number, parentheses from a phone number, dashes, and so on.

VALIDATING DATE STRINGS

I found a better way to validate date strings in *dBASE III Plus*. In this program, a date is represented internally as a number. Its value is the number of days since Ashton-Tate's idea of the beginning of time.

When *dBASE* processes the CTOD() (character-to-date) function, it converts the function's argument to this internal date format without verifying that the argument is a valid date. For example, if you enter

```
? ctod('10/35/90')
```

dBASE will return 11/04/90, since October has 31 days and 4 more will make it 11/04/90. In fact, you can enter

```
? ctod('01/365/90')
```

and *dBASE* will return 12/31/90.

Armed with this knowledge, validating a date string becomes a simple matter of taking the result of the CTOD() function, converting it back to a date string, and comparing the result to the original date string. If they do not match, the date is invalid. The following IF block does the trick:

```
IF (DTOC(CTOD(dstring)) = dstring)
  * a valid date was entered
ELSE
  * an invalid date was entered
ENDIF
```

This will account for leap years and any other input the user may want to type in for a date string. Nantucket's *Clipper* compiler makes this task a little easier, because it allows for UDFs (user-defined functions). The following function can be used to validate a date string:

```
*
* VALDATE() function
*
FUNCTION VALDATE
PARAMETERS dstring
IF (DTOC(CTOD(m->dstring)) =
  m->dstring)
  RETURN (.T.)
ELSE
  RETURN (.F.)
ENDIF

*
* Sample code using VALDATE
* function
*
IF VALDATE(dstring)
  * a valid date was entered
ELSE
  * an invalid date was entered
ENDIF
```

Daniel K. Cahoon
Centreville, Virginia

Validating a date string
in *dBASE III Plus* is a
simple matter of taking
the CTOD () result,
converting it back to a
date string and
comparing the result
to the original date
string.



If you need to validate dates stored in character format (instead of using a date variable), this trick can come in quite handy. In *dBASE III Plus* and *dBASE IV*, an invalid date string passed to the CTOD() function results in a

different date entirely, as Mr. Cahoon clearly depicts above. In *Clipper* (and *FoxPro*), the CTOD() function returns an empty date when an invalid date is passed. Both of these facts are used rather handily in the technique shown above. Keep in mind, though, that this technique assumes that a nonblank date was entered. For example, the VALDATE routine will return .T. for a blank date (''), so you should make sure that a nonblank date string is acquired prior to validation or check for a blank date inside the VALIDATE logic itself. For the latter, you may do something like the following in *Clipper*:

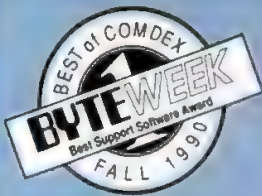
```
*
* VALDATE() function
*
FUNCTION VALDATE
PARAMETERS dstring
* Check for blank date
IF EMPTY(CTOD(m->dstring))
  RETURN (.F.)
ENDIF
* Check for valid date
IF (DTOC(CTOD(m->dstring)) =
  m->dstring)
  RETURN (.T.)
ELSE
  RETURN (.F.)
ENDIF
RETURN (.F.)
```

USING THE RIGHT MOUSE BUTTON

Navigating *FoxPro*'s command window with a mouse really impressed me. Using the mouse, you can scroll the command window to locate any previously entered command and then reexecute it. But to do so, you have to leave the mouse and press Enter on the keyboard. I've found an alternative that lets you keep your hand on the mouse. The following statement does the trick:

```
ON KEY LABEL RIGHTMOUSE
  KEYBOARD CHR(13)
```

The line above tells the *FoxPro* program to place an Enter key in the keyboard buffer whenever the right mouse button is pressed. As a result, I can scroll the command window to the command that I want, select it, click the right mouse button, and watch the command execute—all without ever having to move my hand from the mouse! Moreover I don't have to remember to enter the ON KEY statement all the time, because I have included the following line



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PCM

Databases

as the last line in my CONFIG.FP file:

```
COMMAND=DO STARTUP
```

My STARTUP.PRG file contains the ON KEY LABEL statement. Now, whenever I run *FoxPro*, the STARTUP program is run and the mouse is automatically configured with the right mouse button acting as an Enter key.

Vincent Harris
Sebastopol, California



FoxPro's ON KEY LABEL command is powerful indeed. With it you can execute a command whenever a specific key is pressed. For example, you could use an ON KEY LABEL command to call up a chart of accounts whenever the F10 key is pressed. You would do this by coding an ON KEY LABEL statement that triggers your chart-of-accounts program. For example:

```
ON KEY LABEL F10 DO DispAccts
```

This way whenever the F10 key is pressed, *FoxPro* will execute the DispAccts program.

To code the ON KEY LABEL command, you have to specify the LABEL name of the key that acts as the trigger as well as the command to execute when that key is pressed. Valid LABEL names include all of the regular keys as well as the function keys and most Alt-, Ctrl-, and Shift-key combinations.

In addition, starting with *FoxPro*, Release 1.01, you can use the MOUSE, RIGHTMOUSE, and LEFTMOUSE labels to specify commands that get executed when mouse events occur. The MOUSE label represents either mouse button, while the RIGHTMOUSE and LEFTMOUSE buttons represent the right and left mouse buttons, respectively. A single click on either one of these acts as the trigger.

Mr. Harris's use of the right mouse button does indeed make *FoxPro's* command window more palatable to dedicated mouse users. Moreover, once the right mouse button has been assigned to the Enter key, it can be used that way in other situations.

Another possible use for the right mouse button is as a mouse alternative for hitting the Esc key. The following line does the trick:

```
ON KEY LABEL RightMouse  
KEYBOARD CHR(27)
```

Since you can have multiple ON KEY LABELs active at one time, there are a lot of possibilities. Keep in mind that ON KEY LABEL conditions are not active during the WAIT command or the INKEY function.

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Sal Ricciardi is a New York-based consultant and a frequent contributor to PC Magazine.

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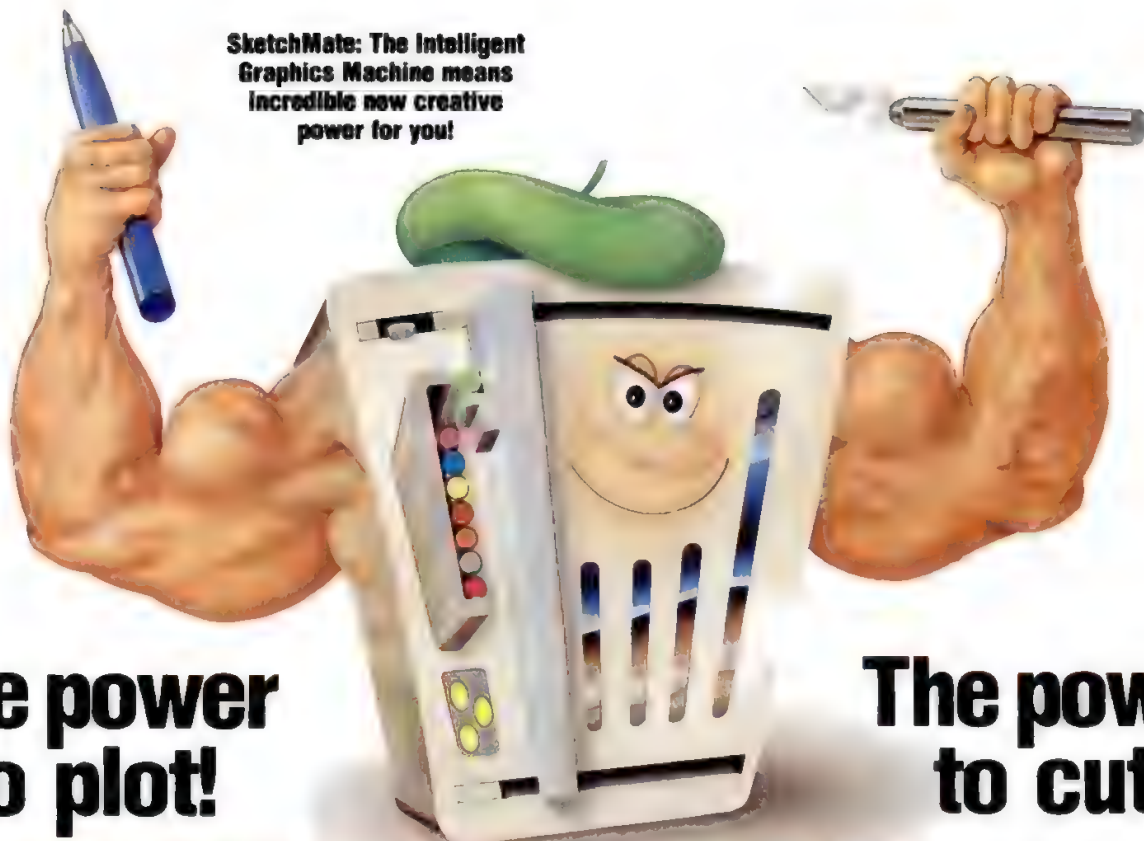


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by
Craig Stinson

Spreadsheets

PRINT DISCRETE RANGES WITH ONE STROKE

I often want to print out a standard set of five to ten long tables from a single *Lotus 1-2-3* spreadsheet. I used to waste a lot of time waiting for each print operation to finish before selecting the next print range. I tried setting up long print macros that specified each range to be printed, but that approach required a new macro for each new set of print ranges.

Finally, I developed the simple generic macro shown in Figure 1. This macro, which works for all my spreadsheets, prints the first to the *n*th named ranges, thereby letting me work uninterrupted until I hear the printer stop.

Cell B4 of this macro uses a dynamic string formula. In creating the macro, you should not enter the statement

```
{RIGHT 0}
```

which appears on the worksheet. Instead enter the formula

```
+ "{RIGHT "&@STRING(COUNTER,0)&"}"
```

which appears as a label in cell C4.

Before running the macro, I enter the number of worksheets I want to print in the cell named Stop. When I press Alt-R, the macro invokes the {NAMES} command to display a horizontal menu of the named ranges in my worksheet. Then it

■ **PRINT DISCRETE RANGES WITH ONE STROKE:** Don't waste time sending several commands to the printer. One macro can do most of the work.

■ **MODIFYING THE FILE OPEN DIALOG BOX:** Tailor the *Microsoft Excel* interface to suit your needs. The macro explored here changes the File Open wildcard spec to *.XLW.

uses the counter of a FOR loop to control how far right the cursor moves through the list of ranges before selecting a range name to print. On the first pass through the FOR loop, the counter is 0, so the cursor doesn't move at all. The macro therefore prints the first range name in the list. On the second pass, the cursor moves one stop to the right, and the macro prints the second range in the list. This continues until the specified number of ranges has been printed.

For all this to work, the ranges I want to print need to appear alphabetically ahead

of all other named ranges on the worksheet. I meet this condition by giving all my print ranges names that begin with the character 1.

Ronald Mitchell
Cambridge, Massachusetts



Mr. Mitchell's macro has the virtue of extreme simplicity, although it requires you to perform two steps manually before you run it. You have to enter the number of worksheets in the Stop cell and you have to ensure that all the ranges you want to print have names beginning with 1.

It occurred to me while reading over this letter that, if you don't mind the trouble of assigning range names that begin with one or more common characters, you could create a macro that would let you choose between several groups of print ranges. One group could have names beginning with 1, another could have names beginning with 2, a third could have names beginning with BUDGET—and so on. And because 1-2-3 lets you assign more than one name to the same range, some of your ranges could belong to more than one group.

Figure 2 lists such a macro. It starts by asking you what group you would like to print. You respond by typing the character or group of characters that defines the group. To print all ranges beginning with 1, type 1. In order to print all ranges beginning with the characters BUDG, type BUDG—and so on.

Note that two cells in this macro use dynamic formulas. The formula you must enter at B8 is

```
+ "{z(esc)"&GROUP&"~1fq"
```

The formula you must enter at B10 is

```
+ "/PPR"&PRINTRANGE
```

Both of these formulas return ERR when you type them in. As the macro runs, they'll be converted to legal macro statements.

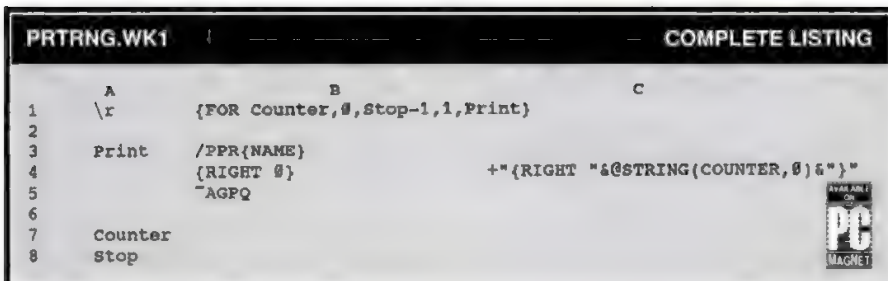


Figure 1: This *Lotus 1-2-3* macro lets you print several named ranges from one worksheet. Before you run the macro, enter the number of ranges you want to print into the cell called Stop. When you run the macro, it will invoke the Names menu command and move across the horizontal listing, printing each range until it reaches the number you specified.

Spreadsheets

Because this embellished macro won't necessarily be printing the ranges that come alphabetically at the top of the list, it can't use a loop counter and the {NAMES} menu to select print ranges. Instead, it creates a worksheet table of range names (with /Range Names Table) and uses the

MODIFYING THE FILE OPEN DIALOG BOX

Microsoft Excel's File Open dialog box normally lists all files matching the wildcard specification *.XL*. The problem with this is that I save most of my Excel documents as workspace files, so I'd prefer that the dialog box list only the .XLW files. I wrote the macro shown in Figure 3 to modify the File Open command so that it does just that. Now, whenever I want to

in any directory list. This factor makes it quite difficult to locate a particular .XLW file in a *.XL* listing.

You can make it easier to find workspace files by prefixing all their names with a hyphen (-). That way, they'll come alphabetically prior to files with standard names, and they'll always appear at the top of the file list. While this offers one alternative, I must point out that Mr. Stacy's macro is a more elegant solution.

The macro uses the SEND.KEYS function, which simply passes keystrokes to Excel as if they were typed at the keyboard. This way, the macro acts more like the 1-2-3 variety and less like a typical Excel macro.

Most Excel macros are built with command-equivalent functions—statements that simulate ordinary Excel commands. But remember, Mr. Stacy's macro doesn't carry out a complete command. It adds a command to the File menu, opens the File Open dialog box, changes the wildcard specification—and it stops right there. Since it executes only part of a command, the macro can't be carried out with a command-equivalent function. The SEND.KEYS function, employed in Mr. Stacy's macro, is designed to handle exactly this kind of situation.

The argument for SEND.KEYS specifies the keystrokes between a pair of quotation marks. As in 1-2-3 spreadsheets, nonalphabetic keys must be expressed in terms of special names or symbols. The two nonalphabetic keys that are used in this macro are Alt and Enter. The symbol for Alt is the percent sign (%), and the name for the Enter key is {enter}. When you want to simulate the act of holding down the Alt key while pressing one or more characters, enclose those characters in parentheses of their own. For example, if you want the macro to hold down the Alt key while pressing N, you would write the line like this:

```
=SEND.KEYS ("% (n) ")
```

PRTGRP.WK1		COMPLETE LISTING	
1	A	B	
2	\r	{ONERROR Stop}	
3		{WINDOWSOFF}{PANELOFF}	
4		{GOTO}Table	
5		/re{END}{DOWN}{RIGHT}	
6		/rntTable	
7		{GETLABEL "Print which group? ",Group}	
8	Findloop	/rs{Backspace}.{End}{Down}	
9			ERR
10		{LET Printrange,@cellpointer("contents")}	ERR
11		-agpq	
12		{DOWN}	
13		{BRANCH Findloop}	
14	Stop	{WINDOWSON}{PANELON}{Home}{QUIT}	
15			
16	Group		
17	Printrange		
18			
19	Table		

Figure 2: This macro expands on the one in Figure 1. Like PRTTRNG, PRTGRP lets you print out several named ranges. It differs in that it will print all the named ranges that share a common first character or group of characters. Your only obligation is to assign range names.

/Range Search Labels Find command to pick out the appropriate names. When all names beginning with the designated character have been printed, the search command generates an error. That error is trapped by the macro's ONERROR statement, which sends control to the cell named Stop. That cell puts the cursor at home and returns 1-2-3 to Ready mode.

Before running this macro, be sure that the range named Table is located in a place where 1-2-3's /Range Name Table command won't overwrite any valuable data. The safest place of all is at the lower-right corner of the worksheet—a spot you can find by pressing End-Home. But any other region where you have plenty of vacant rows and at least two vacant columns will do.

Also, note that the macro will return the cell pointer to A1 and stop if it encounters any error condition—not just when it runs out of ranges to print. This will happen, for example, if your printer is turned off or if a range in your print group has an invalid address.

open a workspace file, I press Ctrl-W to activate the macro, and Excel's File Open dialog box displays only those files matching the spec *.XLW. Figure 4 illustrates the modified dialog box. You should note that I can still use the original file specs by selecting the File Open command.

Christopher L. Stacy
Napa, California



Workspace files encapsulate two or more Excel documents, so they're more than likely to be outnumbered by other files at least three to one

XLWSPEC.XLM		COMPLETE LISTING	
1	A	B	
2	OPEN.XLW	Open a Workspace file	
3	=SEND.KEYS ("%fo")	Choose File Open command	
4	=SEND.KEYS ("(*.xlw)",TRUE)	Change extension to .XLW.	
5	=SEND.KEYS (" {enter} ",TRUE)	Press Enter key	
6	=RETURN()		

Figure 3: This Excel macro issues a series of SEND.KEYS commands that make *.XLM the wildcard specification of the File Open dialog box. In order to display the modified box you must press Ctrl-W.

Spreadsheets

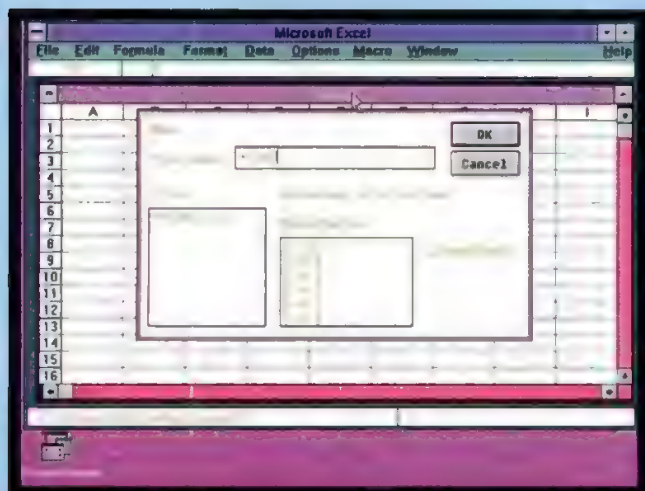


Figure 4: This modified File Open dialog box replaces the usual *.XL* file specification with *.XLW* so that you choose from only Workspace files. You can reinstate the full listing by manually typing *.XL* in the File Name box. The custom box was created by the macro in Figure 3.

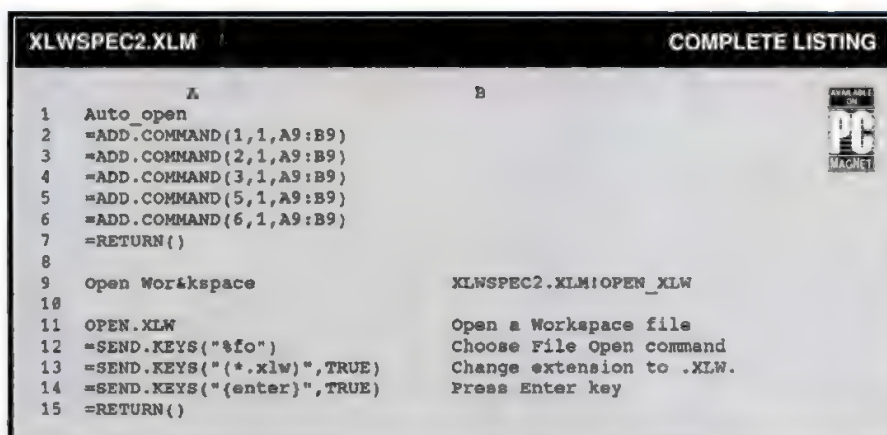


Figure 5: This expansion of Figure 3's macro adds the Open Workspace command to the File menus of five menu bars. You can then invoke the *.XLW* File Open dialog box from the long and short Worksheet/Macro sheet, the long and short Chart menu, and the Nil menu bars.

Mr. Stacy's macro uses six different SEND.KEYS statements. This is convenient for adding the comments listed in Figure 3. But you can save yourself some typing if you enter the entire keystroke sequence in a single statement. In other words, you could replace the six SEND.KEYS statements in A2:A7 with the following line:

```
=SEND.KEYS("%fo*(n)*.xlw(enter)")
```

Figure 5 shows how you can add Mr. Stacy's macro to the File menu of six of Excel's standard menu bars—the long and short Worksheet/Macro sheet menus, the long and short Chart menus, and the Nil menu (which appears when no documents

are open). I've also assigned the name Auto_open to cell A1 of this macro sheet so that Excel will automatically enter the command Open_Workspace to your File menus whenever you load STACY.XLM. (If you change the name of the macro sheet, be sure to modify the statement in B9.)

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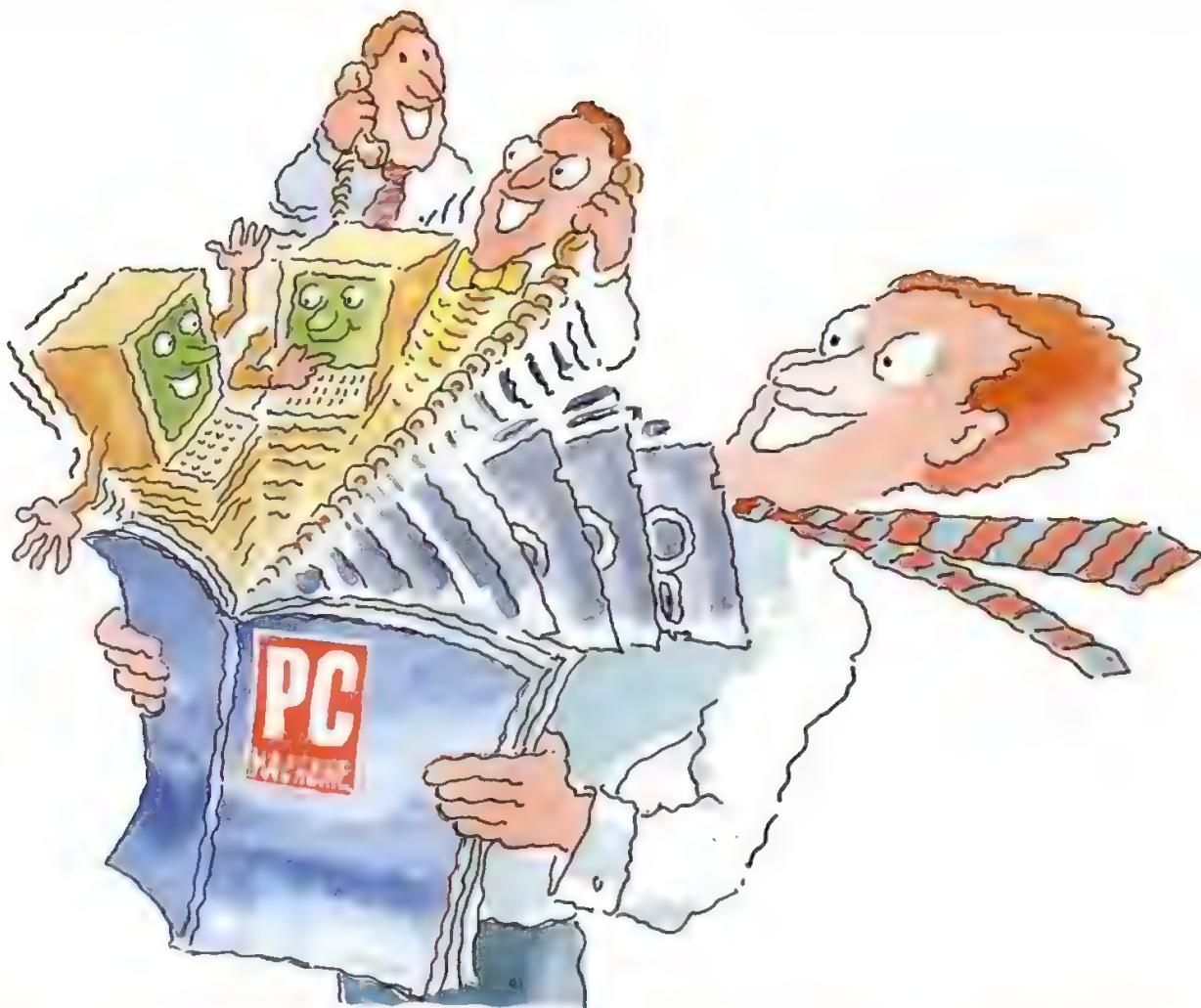


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CIRCLE 497 ON READER SERVICE CARD

by
Costa Rodis

The Working Word

DOCUMENT STAMPS

The *Word for Windows* macro shown in Figure 1 inserts the current path, filename, date, and time into your document at the cursor; the date and time are placed in parentheses. The heading produced by the macro would look something like this:

```
C:\WINWORD\LIBRARY\LETTER.DOC
(1/29/91 at 9:42 PM)
```

Naturally, the macro will also insert the information into a header or footer.

If you use the macro before you've saved the document, only the default filename—not the path—will be inserted. The Macro~Assign-To-Menu function will let you add the macro to the Insert menu for easy retrieval.

Kenneth Buchholz
Washington, New Jersey



Mr. Buchholz's straightforward macro takes full advantage of Microsoft WordBASIC. The possibilities of this particular macro are quickly apparent. You can include any additional text, such as a company or client name, by adding the statement

```
D$ = "text"
```

this would have to be followed later by

■ **DOCUMENT STAMPS:**
Use a simple *Word for Windows* macro to insert path, filename, date, and time into your documents.

■ **STAMPING IN WORDPERFECT:** Use the sophisticated macro language of Version 5.1 (and a single keystroke) to insert any information into a header or footer.

the statement below:

```
Insert D$
```

You should, of course, replace the variable with the text you want to insert. Unlike good old-fashioned BASIC, which allows you to print literal text strings, WordBASIC forces you first to define the text as a variable and then to indicate when and where it is to be inserted into the document. But this procedure allows you to manipulate the text with greater flexibility than is possible in BASIC.

When typing out the macro, reproduce the spacing exactly as you see it. Otherwise, you'll be faced with one or more error messages. For example, each X\$ = statement has a space preceding and following the = symbol. On the other hand, InsertDateField is typed as one word.

Experienced programmers will find WordBASIC a snap to work with. Unfortunately, most everyday users are likely to find it terribly confusing. It's not that WordBASIC is truly difficult to learn and understand. Rather, Microsoft has omitted any kind of macro language primer from either the *Word for Windows* documentation or the technical reference manual (sold separately). I have yet to find a single third-party *Word for Windows* book that can jump-start the beginner into the complexities and delights of this sophisticated language.

If you have some proficiency in BASIC, you should have no problem constructing fairly complex macros, including one that generates dialog boxes. Newcomers to BASIC and *Word for Windows* have no recourse but to pick up a good beginning BASIC text and take it from there. However, be aware: similar does not mean identical. As fun as it would be, standard BASIC programs cannot be run as *Word for Windows* macros. The converse is also true. The logic and struc-

INSERT FILENAME

```
Sub MAIN
REM All Word for Windows macros must begin with this statement.

A$ = " ("
REM The letter A is assigned a space and the begin parenthesis.

B$ = " at "
REM The letter B is assigned the text string " at ".
REM All text strings must be surrounded by quotation marks.

C$ = ")"
REM The letter C is assigned the end parenthesis.

Insert FileName$(0)
REM The current file name and path are inserted at the cursor.

Insert A$
REM A space and the begin parenthesis are inserted
REM immediately after the file name.
```

COMPLETE LISTING

```
InsertDateField
REM The current date is inserted after the begin
REM parenthesis.

Insert B$
REM The word "at", with a space before and after it, is
REM inserted following the current date.

InsertTimeField
REM The current time is inserted after the word "at".

Insert C$
REM The end parenthesis is inserted immediately after
REM the current time.

EndSubAll
REM Word for Windows macros must end with this statement.
```



Figure 1: This *Word for Windows* macro inserts the date, time, and filename into your document. The stamp is placed at the cursor.

The Working Word

ture of WordBASIC and BASIC are similar—the actual code of each is not.

WordPerfect 5.1 mavens will be interested to know that they can insert the current filename into a document. The following letter lets you in on the secret.

STAMPING IN WORDPERFECT

A simple WordPerfect 5.1 macro (shown in Figure 2) will insert the document name into a footer for easy reference on the printout. You can use the macro as is or as a subroutine. If you want to create a header (rather than a footer), simply replace the command

PFAP

in the second line with

PHAP

Note that the macro will work only if you have first saved the file.

Julie J. Westergren
Orem, Utah

Like the *Word for Windows* macro above, this WordPerfect version implements complex and little-understood commands in a simple and elegant manner. The {SYSTEM} command supplies information about the present condition of the program. The statement {SYSTEM}Page~, for instance, returns the current page number. Other parameters include the path, filename, printing status, and current font. Note that using {SYSTEM} as part of an {IF} or {WHILE} expression will not insert a system variable into text. Instead, that variable might be used for comparison or in order to determine a specific condition. Also keep in mind, as Ms. Westergren hints, that the macro will not produce a document name

STAMP.WPM

COMPLETE LISTING

```
{DISPLAY OFF}          {;}Turn off display~
{Home}{Home}{Up}      {;}Go to top of document~
{ENTER}{ENTER}{Up}{Up} {;}Make space at top of~
                        {;}document and place cursor~
                        {;}there~
{Flush Right}{Bold}    {;}Place cursor at right~
                        {;}margin and turn on bold~
{SYSTEM}PATH~          {;}Tell WordPerfect to type~
                        {;}the current path at the~
                        {;}cursor~

{Underline}{SYSTEM}name~
{Underline}            {;}Turn on underline, tell~
                        {;}WordPerfect to type the current~
                        {;}document name, turn off~
                        {;}document name~/~
                        {;}space before and after slash~

{INPUT}Enter"your"name"and~
tap"ENTER"              {;}Place message at bottom of~
                        {;}screen~
{Print}F                {;}Print entire document~
{Search Left}{Flush Right}
{Search}                {;}Search left for flush right~
                        {;}code~
{Del to EOL}            {;}Delete everything to right~
                        {;}of cursor~
{Backspace}{Del}{Del}   {;}Delete flush right code and~
                        {;}two returns~
```

Figure 3: This macro is an embellishment of the one in Figure 1. It accumulates the path, filename, and the name of the person who last modified the document and places the information at the beginning or end of the document. The macro then prints the document with the stamp.

unless the document has first been saved; {SYSTEM}Name~ cannot return a name to a document that has not yet been named. A nine-page list of system variables can be found in Appendix K of the WordPer-

stamp that includes the path, the name of the document, and the name of the person who last modified the text. To accomplish this task with little fuss, all draft printing could be generated with the STAMP.WPM macro, shown in Figure 3. The final version could be printed normally, by holding Shift and tapping F7.

The STAMP macro adds two lines to the top of every document. If you don't want these lines, jettison the {ENTER} strokes and the last two {DEL} codes. Also, if you want to place the stamp at the end of the document, replace

{Home}{Home}{Up}

with

{Home}{Home}{Down}

and omit the same codes noted above.

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Costa Rodis is a computer consultant in New York City.

The logic and structure
of WordBASIC and
BASIC are similar—
the actual code is not.

fect 5.1 manual.

The NAME macro does not actually print the document. But most people need a stamp only at the time of printing and then at the top or end of the text. Let's say a law firm wants all drafts printed with a

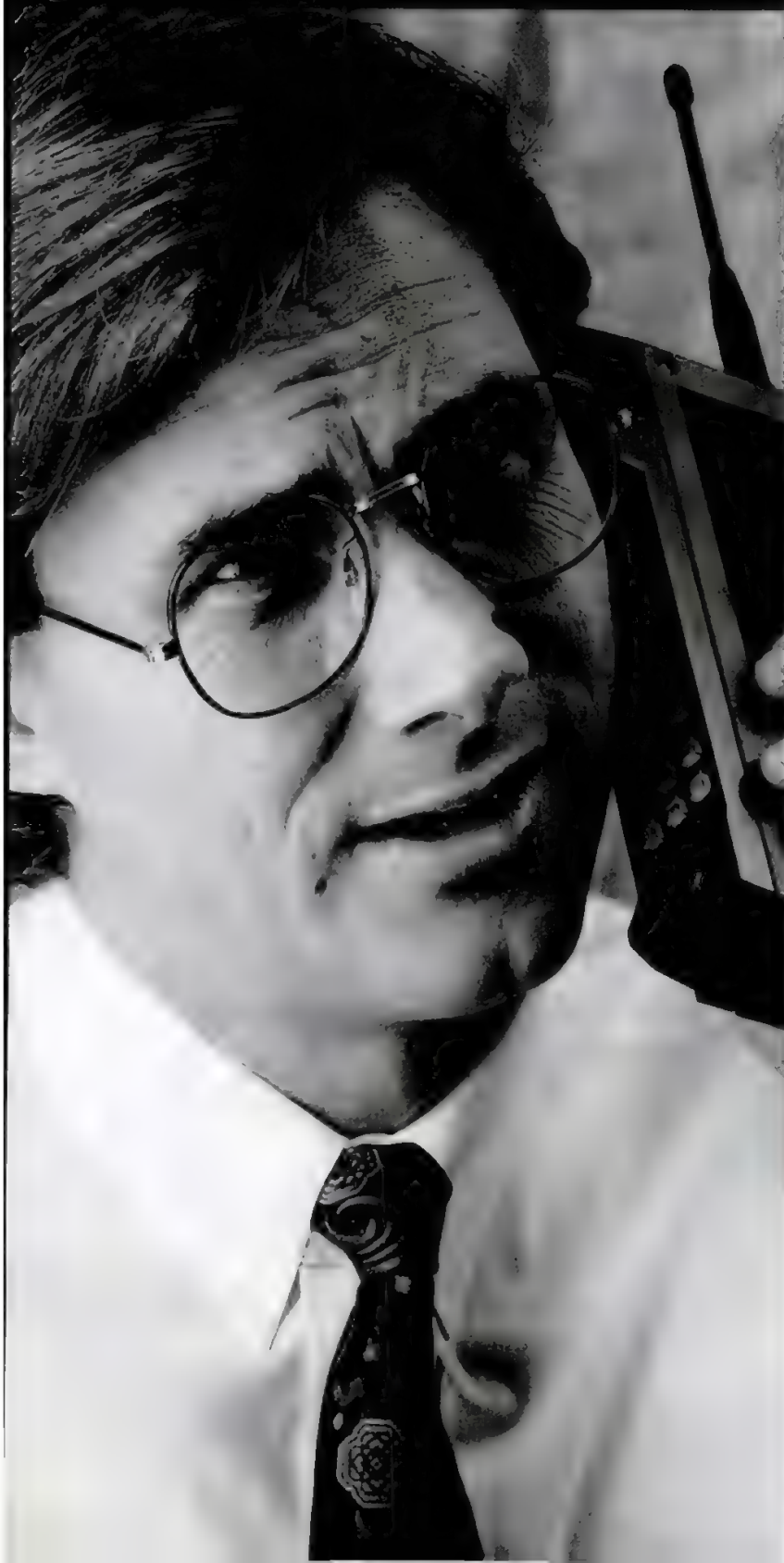
NAME.WPM

COMPLETE LISTING

```
{DISPLAY OFF}          {;}Turn off display~
{Format}PFAP           {;}Shift-F8 for Format, Page, Footer,~
                        {;}A, every Page~
{SYSTEM}PATH~          {;}Tell WordPerfect to type the current~
                        {;}path at the cursor~
{SYSTEM}NAME~          {;}Tell WordPerfect to type the current~
                        {;}document name~
{Exit}                  {;}Exit from Footer A~
{Exit}                  {;}Exit from Format to document~
```

Figure 2: The WordPerfect 5.1 macro places the document name into a footer. To create a header, change the command PFAP to PHAP.

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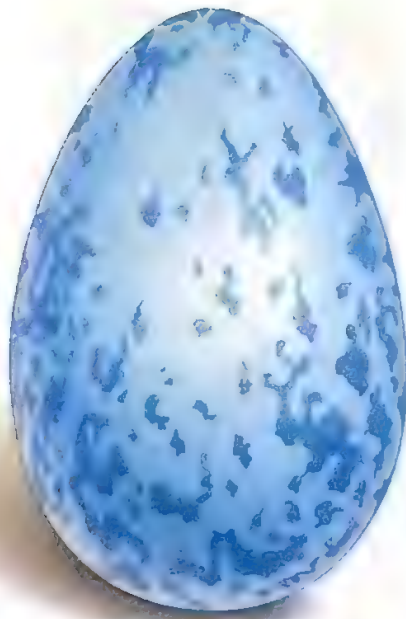
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by
Neil J. Rubenking

User-to-User

TRANSFERRING FILES

One of the most basic requirements of file data is for it to be transportable. Floppy disks provide this capability—to a point. How many of us have tried to transfer many files from one hard disk to another? Transferring more files than fit on a single disk soon becomes tedious. In this scenario, a COPY of all files usually results in an “insufficient disk space” error. Copying the files one disk at a time is an oppressive chore; add the minor requirement of including subdirectories and you have major complications and a recipe for a full-fledged brain cramp! Isn't this exactly the kind of task computers ought to simplify?

There are packages that handle this chore painlessly with specialized software and cables, but these may be overkill for occasional transfers, and they require that the communicating computers be in close proximity. Buying such a package usually isn't justified for the casual user. Besides, shouldn't this be possible without third-party solutions?

Here's a technique for transporting files among computers that requires only DOS commands! The method uses the DOS BACKUP and RESTORE commands—with a twist. These commands have many desirable qualities but are normally limited to replicating exact directory structures. For example, if you BACKUP a directory on the source computer called C:\WP\FILES\MAIL\LETTERS, then RESTORE restores that exact same directory structure on the target. When moving files, you don't want to be hampered by such a restriction. Ideally, the transfer capabilities should be totally generalized so that any files can be moved anywhere.

The problem can be solved with DOS SUBST. This command was designed for “applications that do not recognize paths.” Essentially, it equates a drive letter with a subdirectory. After you enter

```
SUBST L: C:\WP\FILES\MAIL\LETTERS
```

the “root” directory of the new drive L: is ac-

■ **TRANSFERRING FILES:**
SUBST and BACKUP give you an easy way to move files between computers.

■ **ENDING BATCH FILES:**
Some DOS versions get confused if the last line of a batch file is a label without a carriage return after it.

tually the same as the directory on drive C:.

When DOS added subdirectories, the SUBST command was introduced to support “ignorant” applications that didn't support subdirectories. For example, after the above substitution, you could access drive L: from such an application.

The LASTDRIVE value must be set in CONFIG.SYS to include the highest SUBSTituted drive. In the example, you'd need LASTDRIVE=L. You can indicate a LASTDRIVE up to Z, making the entire alphabet reserved. (Note that this could prevent some applications, such as the Novell NetWare shell, from functioning properly).

How can this help you transfer files with the BACKUP and RESTORE commands? It allows full generality, so you can move files where you want. Here's an example: Say that files on the source computer are on the L: drive, as defined above. You start your transfer with the command

```
BACKUP L:\ A: /S
```

where A: is the letter of the floppy disk drive, and the /S directive tells BACKUP to include subdirectories of L:. Now suppose that the destination directory on the target computer is C:\FILE\LETTERS. SUBSTitute drive M: for that directory; the target is then ready for the command

```
RESTORE A: M:\ /S
```

Voilà! DOS prompts for disk swaps and takes care of all the grunt work.

Note that the SUBST drive letters on the source and target don't have to match. The BACKUP and RESTORE commands are path-dependent but not drive-dependent, which is fortunate for this application. To make sure that you back up from the root of the substituted drive, explicitly specify the root in the BACKUP and RESTORE commands, as shown above.

Both BACKUP and RESTORE support the use of wildcards. You can transfer a subset of the files on a given SUBST drive, and you can restore a subset of the files in a set of transfer disks. If you don't specify a wildcard file specification, *.* is assumed.

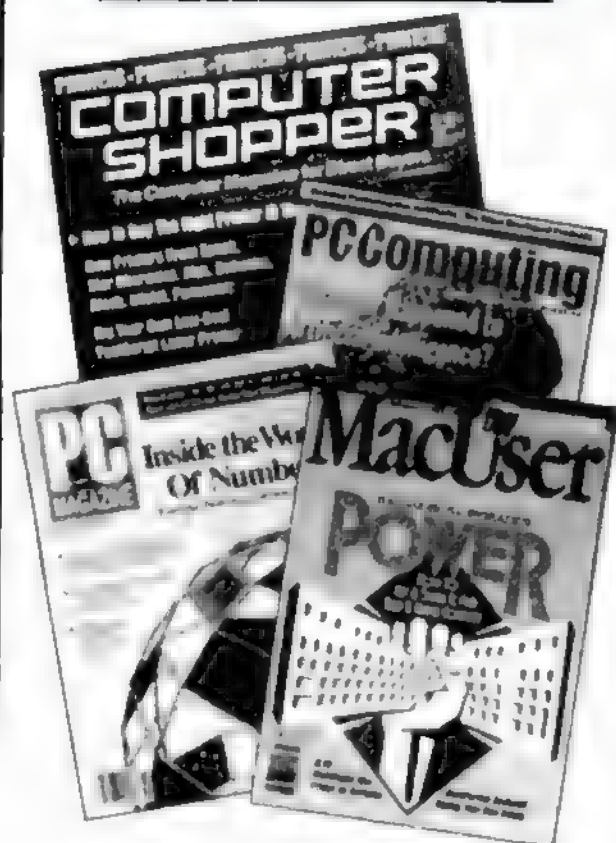
The BACKUP command has some other neat features. With the /F flag the transfer diskette is formatted (appropriately by executing the DOS FORMAT command), and with /A the backup adds the current files to those already on-disk. Even better is the /L flag, for /log. This records the name of every file saved during the backup in the file BACKUP.LOG in the root directory of the source drive. Often there's enough room on the last disk of the transfer to hold a copy of this file. Creating and saving the log file is a good idea, perhaps even critical, because there's no other way to determine the contents of transfer disks other than RESTOREing them.

With this method, files should take less space on the transfer disks than they do on the hard disk. Every file on the hard disk uses a whole number of clusters and, on the average, every file wastes half of its last cluster. But each transfer disk has only two files, BACKUP.n and CONTROL.n. Thus, there are no gaps, or wasted space.

There's one more benefit with this archival method. When files are kept whole and simply transferred without concatenation, systems with no disk caching embark on a frenzy of disk drive head shifting. These seizures occur on both hard and floppy disk drives but are especially aggravated on the latter because of slower access times. They happen because the raw file data re-

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User-to-User

sides at increasingly distant locations from the file allocation table (called the FAT, located at the beginning of the disk) that records file positions. So this access is costly! With BACKUP, however, files are written sequentially and the FAT is updated only once for each. Thus not only is the data shorter, but the operation is faster as well.

So there you have it! Ironically, the DOS manual lists BACKUP and RESTORE as "commands that should *not* be used while a substitution is in effect." Not if you want to take advantage of the useful side effect described here!

Larry Detweiler
Denver, Colorado

PC The DOS manual *may* have some reason for advising you not to use BACKUP and RESTORE while SUBST is in effect. However, I've never found any reason to worry.

Note that the description of disk *thrashing* occurring when you simply copy files applies to the COPY command only. The XCOPY command is smarter—it copies many files at once. First it loads into memory as many of the source files as will fit, and then it copies *all* of them to the destination. XCOPY still has to find each file on-disk, but it avoids most of the flipping back and forth between the two disk drives.

BACKUP and RESTORE are just about the slowest and least flexible pair of backup programs around. Almost any commercial backup utility is better. If you have your own favorite utility for backing up data, you can certainly use it in place of BACKUP and RESTORE in the technique described above.

ENDING BATCH FILES

I like to terminate my batch files with a Ctrl-Z at the end of the final line. This prevents a double DOS prompt from appearing when the batch file finishes running. But it also creates another problem if the last line is a label. To see what happens, create TEST.BAT. At the DOS prompt, enter these lines:

```
COPY CON TEST.BAT
DIR
: end^Z
```

Press Ctrl-Z at the end of the last line, followed by the Enter key.

Run TEST.BAT under DOS 3.3. The

penultimate command gets repeated! In this case it displays the directory twice. Run the same file under DOS 3.2 and it clutches at the end with a spurious "Intermediate file error during pipe" message. Oddly enough, DOS 2.1 handles the sequence just fine. Of course the content of this file is meaningless, but it demonstrates the phenomenon. There certainly are many occasions when the final line of a batch file will be a label.

The fix? Insert GOTO end as the next-to-last line. I suspect DOS 3.3 goes there twice under 3.3, but it looks and works right regardless of the DOS version.

Don Phillip Gibson
Winfield, Kansas

PC There's a twofold problem here. First, in some cases, batch files generate two DOS prompts when they finish. And solving this problem can create a situation that confuses DOS.

The doubled DOS prompt occurs only in batch files that do *not* set ECHO OFF. In such a batch file, if the final line ends with the normal carriage-return and line-feed (CR/LF) sequence, it displays the DOS prompt twice on completion. If the last line ends without a CR/LF pair, you don't get the doubled prompt.

However, as the example shows, DOS has a problem when you omit the final CR/LF on a line that is a *label*. The line before the label executes twice. Note that this doesn't happen if the batch file arrives at that final line via a GOTO. It only occurs when the next-to-last line is encountered during normal sequential execution. That's why you can solve the problem by making the next-to-last line a GOTO.

There's another occasion when you need to leave off the CR/LF pair from a batch line. That's when you want the last line to delete the batch file itself. Perhaps you want to speed up operations by copying a certain batch file to a RAM disk, but once it's done, you want it to delete itself. If the line that deletes the batch ends in CR/LF, DOS will give you an error message. Take away CR/LF and the error message disappears.

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UNDOCUMENTED DOS FUNCTIONS

From time to time, I read about undocumented DOS functions in *PC Magazine*. Can you explain some of these functions and document their uses and calling conventions?

Stephen B. Coffman
Anaheim Hills, California



You bet. Figure 1 shows a partial list of undocumented DOS functions (marked *reserved* in most DOS technical references). There are more, but these are some of the most interesting—and useful. Whether you're a programmer or not, you'll find that these functions provide a working education on the internals of DOS.

One of the most useful undocumented DOS functions is function 60h, often called **TRUENAME**. It accepts an ASCII file name (an ASCII string delimited with a binary zero) and returns an unambiguous, fully qualified filename that includes drive and path designators—even across networks. **TRUENAME** sees through the aliases set up by **SUBST** and **JOIN**. And in DOS 4.x it is actually an undocumented command that you can type at the command line. So, if you've used **SUBST** to make **F:** a synonym for the directory **C:\DATA\FOO**, then the command **TRUENAME F:\BAR** will return **C:\DATA\FOO\BAR**. This is a service that many application programs have had to provide for themselves in the past. The segment:offset address of the original filename is passed in **DS:SI**; the address of the buffer that will receive the fully qualified version of the filename in **ES:DI**.

Functions 1Fh and 32h return the addresses of drive parameter blocks—tables DOS sets up that contain information about the drives installed in the system—above and beyond what's contained in the block device drivers associated with the drives. The format of the table (also shown in Figure 1) has changed with each major release of DOS, primarily to reflect changes

■ **UNDOCUMENTED DOS FUNCTIONS:** These functions aren't described in any DOS manual, but they provide an interesting view of how DOS works.

in the operating system itself. In DOS 4.0, for example, the location that stores the length of each file allocation table in sectors (offset 0Fh) was changed from a byte to a word, in keeping with DOS 4.0's support for large partitions.

Function 37h changes the character DOS recognizes as the switch character, for example, the / in **CHKDSK /F**. The default character is a forward slash, but you can change it to anything you want by passing the ASCII code of the new switch character as an argument to function 37h in register **DL**. Or you can call it with **AL** set to 0 to obtain the current switch character.

You can create a short utility that changes the switch character from a forward slash to a hyphen (as in Unix) with this **DEBUG** script:

```
A 0100
MOV AX, 3701
MOV DL, 2D
INT 21
RET

N SWITCH.COM
RCX
08
W
Q
```

Note that this will work only with DOS commands; application programs may or may not respond to the switch. **SWITCH.COM** will work with DOS commands, but may or may not affect

the way application programs interpret text on the command line. Most applications don't even bother to use function 37h to find out what the current switch character is; instead, they hard-code the switch characters.

RX FOR TSRS

TSR programmers find functions 34h, 50h, 51h, and 5Dh particularly useful. Function 34h returns the segment:offset address of the **InDOS** flag, a 1-byte flag that DOS increments when an interrupt 21h call is made and decrements when the call is completed. By checking **InDOS** before placing a call to a DOS function itself, a TSR can avoid the reentrancy problems that crop up when function calls are nested.

InDOS isn't the only internal flag TSRs need to access. They usually check a second flag, the *critical error flag*, before calling DOS functions. DOS sets this flag to a nonzero state when a critical error occurs, indicating to all concerned that the operating system is in an unstable state and function calls should be restricted. Function 5Dh, subfunction 06h returns the address of the critical error flag in Versions 3.x and 4.x. In earlier versions, finding the flag requires a difficult search through memory for a particular code sequence. The method is described in the *MS-DOS Encyclopedia*.

Although DOS is a single-tasking operating system, it maintains a record of the **PSP** address of the process that is currently in the foreground. When a TSR temporarily grabs control of the CPU, it should activate its own **PSP** before performing any file I/O, and then reactivate the formerly active **PSP** before returning from interrupt (as demonstrated by DOS's prototype TSR, **PRINT.COM**). Functions 50h and 51h, **Set Active PSP Address** and **Get Active PSP Address**, respectively, provide the mechanism for doing so. The former stuffs the segment address of the **PSP** to be activated (passed in **BX**) into the slot where DOS stores the address of

the active PSP. Function 51h does just the opposite, returning in BX the segment address of the active PSP.

Because of an anomaly in the way DOS 2.x handled stack switches internally, calling either of these functions from inside an interrupt 28h handler without setting the critical error flag will cause the system to crash. You can work around this by obtaining the address of the critical error flag first and manually incrementing that value before invoking function 50h or 51h, and then resetting the flag once the function has returned. This quirk was corrected in DOS 3.0.

Function 5Dh, subfunction 0Ah is the undocumented counterpart to function 59h (Get Extended Error Information). DOS uses it to set the register values that will be returned by the next call to function 59h. TSRs use it to restore the extended error information obtained with a call to function 59h prior to performing file I/O themselves. By doing so, they preserve any error information that was pending when they were invoked.

DOS'S LIST OF LISTS

Easily the most informative function DOS provides, function 52h returns the address of a list DOS maintains internally that contains a wealth of information, including pointers to other lists (hence the term *list of lists*). From the table whose address is returned by this function (and whose format is dependent on the DOS version), you can ascertain, for example:

- where the first memory control block is located in memory, useful for tracking the chain of memory control blocks DOS sets up;
- where the chain of drive parameter blocks begins (the address of individual drive parameter blocks can be obtained with functions 1Fh and 32h);
- where DOS locates the CON, CLOCK\$, and NUL device drivers, and, from the address of the NUL driver, where the chain of device drivers begins (and thus where any other device driver is located);
- where DOS keeps its system file tables, in which information about open files is stored;
- the number of BUFFERS specified in CONFIG.SYS, where these buffers are located, and what's in them;
- the number of logical drives in the



UNDOCUMENTED DOS INTERRUPTS AND FUNCTION CALLS

Interrupt 21h, Function 1Fh: Get Drive Parameter Block for Default Drive

Call with: AH = 1Fh

Returns: AL = Return code

FFh: Error, drive does not exist

Not FFh: No Error, drive exists

DS:BX = Address of drive parameter block

Description: Returns the segment:offset address of the drive parameter block that corresponds to the current drive. The format of the block is shown below.

Drive Parameter Block Format:

	Offset	Size	Description
All Versions of DOS			
	00	Byte	Drive number (0 = A:, 1 = B:, and so on)
	01	Byte	Unit number within device driver
	02	Word	Number of bytes per sector
	04	Byte	Number of sectors per cluster (minus 1)
	05	Byte	Log base 2 of the cluster size
	06	Word	Number of reserved sectors
	08	Byte	Number of file allocation tables
	09	Word	Number of root directory entries
	0B	Word	Sector where data space starts
	0D	Word	Number of the highest cluster
DOS 2.x			
	0F	Byte	Number of sectors per file allocation table
	10	Word	Sector where root directory starts
	12	DWord	Address of device header
	16	Byte	Media descriptor byte
	17	Byte	Access indicator byte
			FFh: Disk has not been accessed
			00h: Disk has been accessed
	18	DWord	Address of next parameter block
	1C	Word	Starting cluster of current directory
	1E	64 bytes	Current directory (ASCII string)
DOS 3.x			
	0F	Byte	Number of sectors per file allocation table
	10	Word	Sector where root directory starts
	12	DWord	Address of device header
	16	Byte	Media descriptor byte
	17	Byte	Access indicator byte
			FFh: Disk has not been accessed
			00h: Disk has been accessed
	18	DWord	Address of next parameter block
	1C	Word	Starting cluster in search for free space
	1E	Word	Unknown (always FFFFh)
DOS 4.x			
	0F	Word	Number of sectors per file allocation table
	11	Word	Sector where root directory starts
	13	DWord	Address of device header
	17	Byte	Media descriptor byte
	18	Byte	Access indicator byte
			FFh: Disk has not been accessed
			00h: Disk has been accessed
	19	DWord	Address of next parameter block
	1D	Word	Starting cluster in search for free space
	1F	Word	Unknown

Interrupt 21h, Function 32h: Get Drive Parameter Block for Specified Drive

Call with: AH = 32h

DL = Drive number (0 = default, 1 = A:, 2 = B:, and so on)

Returns: AL = Return code

FFh: Specified drive does not exist

Not FFh: Specified drive exists

DS:BX = Address of drive parameter block

Description: Returns the segment:offset address of the drive parameter block that corresponds to the specified drive. The format of the block is identical to the one shown for Function 1Fh.

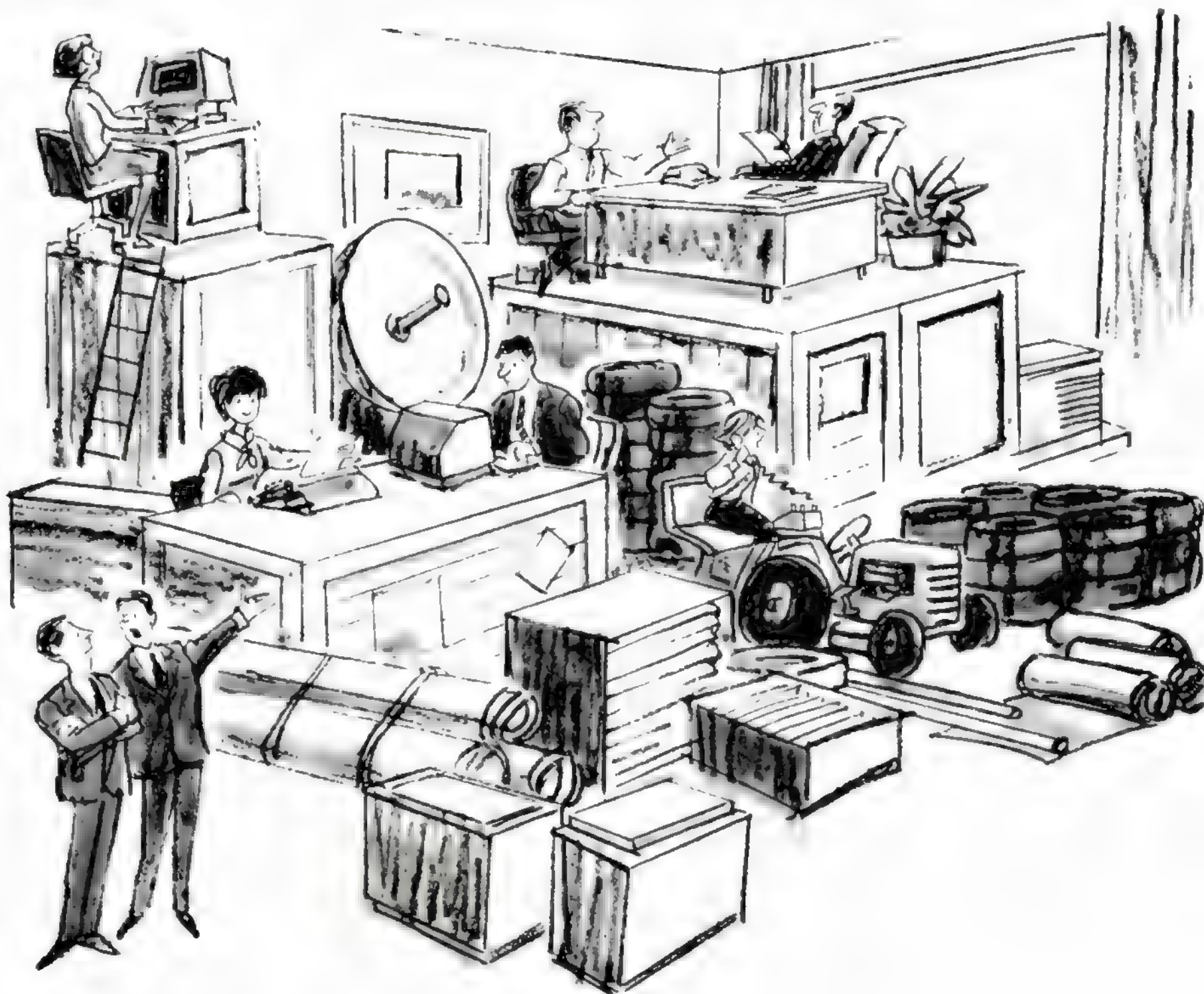
Interrupt 21h, Function 34h: Get Address of INDOS Flag

Call with: AH = 34h

Returns: ES:BX = Address of INDOS flag

CONTINUES

Figure 1: These are some of the most interesting and useful of the undocumented DOS functions. They are marked *reserved* in most DOS technical references.



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system and what LASTDRIVE value was specified in CONFIG.SYS.

Ever wonder how programs such as *Manifest* and PC Magazine Labs' own *MicroScope* (included with the *PC Magazine Benchmark Series*, available on PC MagNet) find out what they do about the structure of DOS? Function 52h provides most of the information. And by using this information, it's possible to snoop around inside DOS and draw conclusions that could never be made by inference alone. An important note related to the values returned in the list of lists is that the byte at offset 17h in DOS 2.x, 22h in DOS 3.x and 4.x, doesn't spell out the address of the NUL device driver; it's the actual beginning of the NUL device driver.

NUL always starts at offset 17h within this segment in DOS 2.x and at offset 22h in DOS 3.x and 4.x. And since NUL is always the first driver in the chain of device drivers that DOS loads into memory, you can use this as a starting point to traverse the chain of device drivers—both system and installable. Since each device driver header contains a pointer to the next driver in the chain, you don't need to know where the NUL driver ends.

OTHER DOS INTERRUPTS

When a DOS function is called to read from the keyboard or serial port, it doesn't return until the input request is satisfied. The InDOS flag remains set the entire time, effectively blocking out any TSR that doesn't dare execute an interrupt 21h until InDOS is cleared. It's actually safe to use DOS functions higher than 0Ch while lower-numbered DOS functions are processed, because higher-numbered functions use a stack that's separate from the one used by functions numbered 01h through 0Ch.

Interrupt 28h, the *DOS Idle Interrupt*, provides an undocumented means for TSRs to make calls to interrupt 21h while DOS processes function calls that leave InDOS set for extended periods of time. But InDOS is a simple flag that provides no indication of which function is currently being processed. To compensate, when DOS waits for user input from functions 01h, 03h, 07h, 08h, and 0Ah, it executes interrupt 28h over and over to signal TSRs that, although InDOS is set, it's safe to use functions above 0Ch. Hence



UNDOCUMENTED DOS INTERRUPTS AND FUNCTION CALLS

Description: Returns the segment:offset address of the 1-byte InDOS flag, a flag DOS sets to indicate when it is processing an interrupt 21h function call. When InDOS is zero, it's safe for programs to call interrupt 21h. When it's nonzero, a call to interrupt 21h may crash the system.

Interrupt 21h, Function 37h: Get or Set Switch Character

Call with: AH = 37h
AL = Subfunction code
00h: Read switch character
01h: Set switch character
DL = Switch character (for subfunction 01h)

Returns: DL = Switch character (for subfunction 00h)

Description: Retrieves or alters the character DOS recognizes as a switch on the command line (/C, -C, for example)

Interrupt 21h, Function 50h: Set Active PSP Address

Call with: AH = 50h
BX = Segment address of PSP to activate

Returns: Nothing

Description: Activates the indicated PSP. Under DOS 2.x, invoking this function from inside an interrupt 28h handler without first setting the critical error flag will crash the system.

Interrupt 21h, Function 51h: Get Active PSP Address

Call with: AH = 51h
Returns: BX = Segment address of active PSP

Description: Returns the segment address of the active PSP. Under DOS 2.x, invoking this function from inside an interrupt 28h handler without first setting the critical error flag will crash the system.

Interrupt 21h, Function 52h: Get List of Lists

Call with: AH = 52h
Returns: ES:BX = Address of list

Description: Returns the segment:offset address of an internal list DOS maintains that spells out the address of the first memory control block, the addresses of the CLOCK\$, CON, and NUL device drivers, and more. The format of the list, commonly called the "list of lists," is shown below.

List of Lists Format:

	Offset	Size	Description
All Versions of DOS			
	02	Word	Segment address of first memory control block
	00	DWord	Address of first drive parameter block
	04	DWord	Address of list of DOS file tables
	08	DWord	Address of CLOCK\$ device driver
	0C	DWord	Address of CON device driver
DOS 2.x			
	10	Byte	Number of logical drives
	11	Word	Maximum number of bytes per block, for block devices (usually 512)
	13	DWord	Address of first disk buffer
	17	Byte	Beginning of the NUL device driver
DOS 3.x and DOS 4.x			
	10	Word	Maximum number of bytes per block, for block devices (usually 512)
	12	DWord	Address of first disk buffer
	16	DWord	Address of drive data array
	1A	DWord	Address of FCB table
	1E	Word	Size of FCB table
	20	Byte	Number of block devices
	21	Byte	LASTDRIVE value (default = 5)
	22	Byte	Beginning of the NUL device driver
	34	Byte	Number of JOINed drives

Interrupt 21h, Function 5Dh, Subfunction 06h: Get Critical Error Flag Address

Call with: AH = 5Dh
AL = 06h (subfunction code)

Returns: DS:SI = Address of the critical error flag

Description: Returns the address of the 1-byte critical error flag. A nonzero value indicates a critical error has occurred in the system. When this flag is set, calls to the DOS kernel should be restricted until processing is complete.

CONTINUES

the name *DOS Idle*: DOS is passing the word that it's sitting in an idle loop waiting for input. All a TSR has to do is tap into interrupt 28h and, if InDOS is set, use the interrupt as a mechanism for gaining control. To detect the occurrence of an interrupt 28h, you have to set up an interrupt handler to trap it. As soon as you've trapped it, you've gained control of the CPU.

Interrupt 29h, the *Fast Console Output Interrupt*, is DOS's undocumented mechanism for passing characters to the console device. To output a character, DOS places the ASCII code in AL and executes an INT 29h. The default console driver, CON, fields the interrupt and uses function 0Eh in the video BIOS (the write- teletype routine) to output the character to the screen. When ANSI.SYS is installed, it takes over interrupt 29h processing from CON and uses interrupt 10h, function 09h to write characters to the screen.

Interrupt 2Eh is also known as the back door to the command processor. Passing a string to DOS with this function causes it to be executed by the top-level command processor, just as if it had been typed at the command prompt. Programmers must be careful to save important registers (including SS and SP) before calling interrupt 2Eh, because it, like DOS's EXEC function, destroys everything but CS and IP. In addition, if the command processor is COMMAND.COM, there must be enough memory available for COMMAND.COM to load the transient portion of itself back into memory, if necessary. This means that if you invoke interrupt 2Eh from a .COM file, you must shrink your own program's memory allocation with a call to function 4Ah first.

Be careful about how you call interrupt 2Eh. If you aren't, you can crash your system in certain very common circumstances. The main one is if the program you're using is running under a batch file. Since INT 2Eh is nonreentrant, DOS uses it to run batch files. So if you run a batch file using INT 2Eh from your program, your system will crash.

CAVEATS

There are two pitfalls to watch out for in using these undocumented functions and interrupts. The first is that they're not supported in all versions of DOS. To the

UNDOCUMENTED DOS INTERRUPTS AND FUNCTION CALLS

Interrupt 21h, Function 5Dh, Subfunction 0Ah: Set Extended Error Information

Call with: AH = 5Dh
AL = 0Ah (subfunction code)
DS:DX = Address of extended error information table

Returns: Nothing

Description: Permits programs to set the extended error information returned by function 59h (Get Extended Error Information). The format of the extended error information table is shown below.

Extended Error Information Table Format

Offset	Size	Description
00	Word	Value function 59h will return in AX
02	Word	Value function 59h will return in BX
04	Word	Value function 59h will return in CX
06	Word	Value function 59h will return in DX
08	Word	Value function 59h will return in SI
0A	Word	Value function 59h will return in DI
0C	Word	Value function 59h will return in DS
0E	Word	Value function 59h will return in ES
10	Word	Always 0
12	Word	Always 0
14	Word	Always 0

Interrupt 21h, Function 60h: Return Fully Qualified Filename

Call with: AH = 60h
DS:SI = Address of ASCIIZ filename
ES:DI = Address of buffer to receive fully qualified filename

Returns: Nothing

Description: Accepts an ASCIIZ (zero-delimited) filename, which may or may not be fully qualified, and converts it into an unambiguous and fully qualified filename that includes drive and path designators.

Interrupt 28h: DOS Idle

Description: Interrupt 28h, the DOS Idle Interrupt, is repeatedly called while DOS functions 01h, 03h, 07h, 08h, and 0Ah wait for input to permit TSRs to invoke DOS services when the InDOS flag is set.

Interrupt 29h: Fast Console Output

Call with: AL = Character to output to console device

Returns: Nothing

Description: Called by DOS to output characters to the console device (CON or ANSI.SYS).

Interrupt 2Eh: Execute Command

Call with: DS:SI = Address of command string (delimited by the character 0Dh—the carriage return character), with the first byte set equal to the length of the string (the length should include the carriage return at the end)

Returns: Nothing

Description: Passes a command line to the command processor and executes it.

ENDS

best of my knowledge, all the ones listed here are available in Version 2.0 and later, with the exception of the following:

Interrupt 21h, function 5Dh, subfunction 06h (Get Critical Error Flag Address), which first appeared in DOS 3.0; interrupt 21h, function 5Dh, subfunction 0Ah (Set Extended Error Information), which first appeared in DOS 3.1; interrupt 21h, function 60h (Return Fully Qualified Filename), which first appeared in DOS 3.0.

The second caveat is that none of these functions is guaranteed to be supported in future versions. That's one reason some of them were originally left undocumented: so that Microsoft wouldn't be committed to supporting them in future releases of

the operating system. Most, however, have become so widely used that they're likely to be retained in future versions so that subsequent releases of DOS won't be incompatible with today's applications.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. To have your questions answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 8 for access instructions). We're sorry, but we are unable to answer questions individually.

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by
Frank J. Derfler, Jr.

Connectivity

SOURCES OF INFORMATION

I'm constantly asked for sources of information on networking and networking products, so here are a couple of reminders as well as some information about a new and interesting newsletter service.

In the September 26, 1990, issue of *PC Magazine*, I told you about *Computer Library* (212-503-4400), the Ziff-Davis compendium of computer publications and newsletters on CD-ROM. I also described the *LocalNetter* and other reports available from Architecture Technology Corp. (612-935-2035). Everyone with an interest in computers in any way can make good use of *Computer Library*, and those of you with technical networking responsibilities will appreciate the reports and special newsletters available from Architecture Technology.

Now I want to introduce those of you who are interested in the long-range strategic aspects of networks and connectivity to another service—the *Clarke Burton Report*. This newsletter service was started by three former Novell employees, Craig Burton and Judith Clarke, who were top executives, and Jamie Lewis, the primary writer and explainer of technology for Novell. Lewis's unheralded work set hundreds of us would-be LAN pundits on the right track. The reports are not inexpensive, but pack a lot of insight.

Clarke Burton sells both a series of monthly reports and a news analysis that comes out 17 times a year. In 1990 the monthly reports discussed interoperability issues, the path of client-server computing, internetwork naming systems, and other strategic topics. The news analysis gives interesting insights into why companies do the things they do. A subscription to both services is \$1,495 per year, and each service is available separately. Call Clarke Burton at 800-657-6340 for more information.

People have also been asking about the PC Magazine LAN Labs' new book, *The PC Magazine Guide to Connectivity*. The book should be out in April and will

■ **SOURCES OF INFORMATION:** Where to find out what you need to know.

■ **A SMART HOUSE:** Build for the future, wire your house with twisted-pair.

■ **THE P STATION COMMAND:** This simple technique assures that the correct CAPTURE commands will always be issued at each workstation.

■ **PORTABLE TOKEN-RING:** Extend your Token-Ring system—or take it with you on the road.

include at least two diskettes with a variety of programs, a fold-out decision guide for PC connection options, a detailed glossary, and lots of diagrams along with the text. I'll tell you how to get the book when it hits the stores.

A SMART HOUSE

I'll be constructing a new home in the near future, and I'd like your advice about installing a flexible, reasonably priced, and logically configured household "wiring harness." I want a system that will anticipate the future connectivity needs of intelligent devices, home computers, and any other systems that might come along.

Norman Elliott
New York, New York



There is a so-called "Smart House" cabling scheme that includes fiber, coax, and twisted-pair, but it hardly meets your criterion that it must be reasonably priced. Although I'd like

to hear otherwise, I think the whole Smart House movement has died under its own weight. But you can create your own smart house.

Tell your electrical contractor that you want the house wired with unshielded twisted-pair wiring that meets the specifications of IBM Type 3 cable. Each cable will have two pairs of #24 AWG wire. The materials run about a nickel a foot, but installation costs vary widely in different parts of the country. If your electrical contractor gives you a blank stare when you mention Type 3 cable, find another contractor. Look for one with experience installing PBX wiring.

It's a good idea to have the wiring checked with a Microtest Pair Scanner to test for loop loss. This device costs \$2,495, but it's an invaluable tool for a professional contractor. Call Microtest at 800-526-9675 for more information on the Pair Scanner.

When we moved the LAN Labs to Florida, I built a new house and loaded it with twisted-pair wiring. I also put dual outlet RJ-11 jacks every 6 feet on the wall of every major room. This means two runs of wire for every wall plate. You typically use one jack for telephone and the other for data systems, but this isn't a hard-and-fast rule. Bring every wire run back by the shortest route to a central wiring box. Mine is a moisture-proof heavy plastic box mounted on the wall of the garage. Make sure the wiring box is near a source of AC power—you might need it for 10BaseT or other types of adapters.

In the moistureproof box, the contractor should mount a Type 110 patch panel. These patch panels have gold connectors and cost from \$300 to \$600 dollars for a 24- to 48-port configuration, but they're worth it.

Don't let your contractor install standard untwisted residential telephone wiring or the older Type 66 punch-down blocks. I had to work very hard to ensure that the people working on my residence did the

Connectivity

job right, even after the contractor seemed to have the necessary details down pat. At one point, they had all the wires running to an outside wall, because that's the way they'd always done residential telephone systems.

A full twisted-pair wire configuration will handle everything you'll do around the house and even any commercial installation except video. So, just in case, I also layed in a heavy cable-television wiring system.

You might want to call South Hills Datacomm at 800-245-6215 and ask for the data communications products catalog. It's loaded with the right stuff to wire your house or a major office building.

THE P_STATION COMMAND

I recently got the job of researching and implementing a PC-based LAN system for our newly formed engineering department. Getting the hardware in place was the fun and easy part; becoming the network administrator was a significantly greater challenge. I look forward to your column in each issue—each one seems to solve yet another of our problems. But here's a problem you haven't mentioned before.

Novell *NetWare*'s CAPTURE command redirects print jobs from applications to the networked printer. *NetWare* eliminates defined CAPTURE commands when a user leaves the network using LOGOFF.

If the user later logs back into the same terminal, the CAPTURE commands have to be reissued from the command line or from a batch file. For example, a batch file called PRINTERS.BAT might contain

```
CAPTURE Local=1 QUEUE=AUTOCAD
NoFormFeed NoBanner NoTabs
Timeout=20
CAPTURE Local=2 Printer=1
NoFormFeed NoBanner NoTabs
Timeout=20
CAPTURE Local=3 Printer=2
NoFormFeed NoBanner NoTabs
Timeout=20
```

or in its abbreviated form:

```
CAPTURE L=1 QUE=AUTOCAD NFF NB NT
TI=20
CAPTURE L=2 P=1 NFF NB NT TI=20
CAPTURE L=3 P=2 NFF NB NT TI=20
```

There are three printers attached to our server, and some client PCs have a local printer as well, so usually no two sets of capture commands are identical. And if you forget to run PRINTERS.BAT before starting and printing in an application, you can lock up the machine if no local printer is present.

My first thought was to insert the CAPTURE commands into each user's personal login script so that the commands would be issued automatically each time a user logged on. The problem with this is that the same set of CAPTURE commands would always be issued for a user, no matter which machine he logged into.

Configuring the system login script so that it universally runs a batch file with a common name in the root directory, such as C:\PRINTERS.BAT, also seemed to be a possible solution. But this doesn't work if some machines don't have a C: drive (as diskless workstations don't). And it makes it necessary for the LAN manager to go to each station to make changes, rather than making them all in one place from the system login script.

I finally discovered a better solution to our printer-spooling dilemma. I used the P_STATION variable, which is unique to each workstation on the network, in the system login script. Here's an example of how it works.

Assume the network address of a workstation is EFh. Also assume that you want to use its local printer on LPT1, spool to a specific network printer via the print queue AUTOCAD on LPT2, and assign LPT3 to another printer designated as network printer 2. You can accomplish this by inserting the following block in the system login script:

```
IF P_STATION='0000000000EF' THEN
BEGIN
  CAPTURE L=2 QUE=AUTOCAD NFF NT
  NB TI=20
  CAPTURE L=3 P=2 NFF NT NB TI=20
ENDIF
```

This simple method assures that the correct, machine-specific CAPTURE commands will always be issued at each workstation no matter who logs into it.

Other non-TSR commands can also be issued in this manner, making life just a little bit easier for the LAN manager. Obviously, this solution is better suited to LANs with a relatively small number of workstations (we have 12) as it would tend to produce a large and increasingly

unmanageable system login script on a LAN with 100 workstations.

Steven McEvoy
San Carlos, California



Novell network administrators become familiar with the use of the P_STATION commands as they gain experience. You can use this technique to solve other problems as well. In the LAN Labs we use several diskless PCs as print and communications servers. Since diskless workstations don't have a bootable drive, they use a file that resides on a server to boot up. This file, called a *DOS image*, contains COMMAND.COM and the DOS hidden files, as well as any CONFIG.SYS or AUTOEXEC.BAT files that the workstation might need. All of these elements are combined into one file used by the boot ROM on the LAN adapter in the workstation. Each different diskless workstation can have a different DOS image. However, by designating the specific P_STATION ID in the system login script, we are able to control which DOS image a diskless workstation uses to boot up.

PORTABLE TOKEN-RING

Your October 30, 1990, column mentioned the Token-Ring extenders marketed by SimWare. Onan makes a similar Token-Ring extender called the DualPort. Onan's product has been available for quite some time, and you can find it in many installations. Many people who need a temporary Token-Ring network for demonstration or evaluation carry an Onan DualPort as a portable Token-Ring system.

Jim Starkovich
Boca Raton, Florida



Using the Onan DualPort Token-Ring extender as a portable Token-Ring system is a neat idea. You can buy it from your local Graybar electrical products distributor for \$288.89.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay \$50 for any tip we print. Please submit your letter on a disk along with a printout. Then mail your contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). We are unable to answer letters individually. ■

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ML2611	12 inch	White	640x480 (VGA)	
ML4571	14 inch	White	640x480 (VGA)	
CK4656	14 inch	Color	640x200 (CGA)	
VGA GraphicMaster (CJ4681)	14 inch	Color	640x480 (VGA)	
CJ4685/CJ4686	14 inch	Color	640x480 (VGA)	
SyncMaster (CT4581)	14 inch	Color	800x600 (Super-VGA)	Multi Scan
SyncMaster2 (CVB4581)	14 inch	Color	1024x768 (Enhanced-VGA)	Interlaced
SyncMaster3 (CVB4587)	14 inch	Color	1024x768 (Enhanced-VGA)	Interlaced
SyncMaster4 (CSA7571)	17 inch	Color	1024x768 (Enhanced-VGA)	Non-interlaced, Flat Screen, Multi Scan
PageMaster (MP5671A)	15 inch	White	1006x1048	Full Page/DTP
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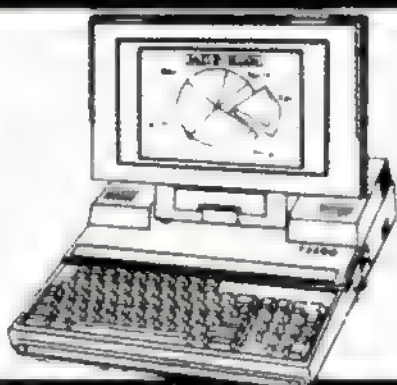
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T1600-40MB: 1/3/5MB 2099/2249/2399

T1600X-40MB: 1/3/5MB 2129/2279/2429

T2000SX-20MB: 1MB/3MB 3079/3349

T2000SX-20MB: 5MB/9MB 3819/4119

T2000SX-40MB: 1MB/3MB 3379/3649

T2000SX-40MB: 5MB/9MB 4129/4429

T3100SX-40MB: 1MB/3MB 3499/3649

T3100SX-40MB: 5MB/7MB 3799/3949

T3100SX-80MB: 1MB/3MB 3679/3829

T3100SX-80MB: 5MB/7MB 3879/4129

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8 bit with 8k / 32k 179/199

16 bit / 16 bit MCA 249/279

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Pocket Ethernet Adapter 429

Pocket Token Ring Adapter 649

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Grey: 4 / 16 level 1899/2399

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NEC 2A 14" SVGA 449

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\$1499 FastData 386/SX

Combine the benefits of an advanced Intel 386 processor, the value of a 286 and the advantages of FastData and you've got the FastData 386/SX! This machine is the choice of those who want to run today's powerful 386 and multitasking software, like Windows, and want to rip through their favorite programs, like Lotus and WordPerfect at blinding speeds. This machine is ideal to run the latest memory demanding and graphic software, right out of the box. We've made our customers' favorite options standard: it comes with an ample two megabytes of memory, a high performance 40mb hard drive, and 16 bit color VGA. Compare performance, features, and service and you will find no better SX value. Interested further? Try the FastData 386/SX for 30 days; you have to be happy - if not, we'll take it back.

Standard Features

- ✓ 16mhz Intel 80386-SX processor. (20mhz optional)
- ✓ 2 megabytes of zero wait-state RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. (Second drive add \$79)
- ✓ Standard chassis with keylock, speed and reset buttons. (Optional chassis add \$50)
- ✓ Five available drive bays.
- ✓ 200 watt power supply
- ✓ 14" VGA color monitor with 16 bit VGA card with 256K.
- ✓ Clock calendar, parallel port, and two serial ports. (Game port included on color systems)
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 available.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add \$99.
- ✓ Compatible with DOS, OS/2, Windows, Xenix and Novell.
- ✓ FCC Class B approved.

System Price	40mb	65mb	80mb	100mb
Monochrome	\$1,199	\$1,269	\$1,399	\$1,469
VGA Color	\$1,499	\$1,569	\$1,699	\$1,769
VGA 1024	\$1,599	\$1,669	\$1,799	\$1,869



FastData 386/25 \$2099

The optimum combination of features, expandability, and power make the FastData 386/25 an ideal choice for those whose applications demand the most from a computer. Whether running as a network fileserver, CAD or graphics station, or power-user's workhorse, the FastData 386/25 handily meets the challenge. It comes configured with a whopping four megabytes of fast RAM, a superfast 22 millisecond 65 megabyte hard disk, and maximum VGA displaying 1024 by 768 resolution powered by a high-output 16 bit 512K VGA board. Plus, the FastMicro team will configure your FastData 386 exactly the way you want, without sending you shopping elsewhere. When evaluating 386-DX workstations, why even consider anything else?

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- ✓ 25mhz Intel 80386-DX processor. (33mhz optional)
- ✓ 4 megabytes of zero wait-state RAM.
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- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. (Second drive add \$79)
- ✓ Standard chassis with keylock, speed and reset buttons.
- ✓ Five available drive bays.
- ✓ 80387-DX coprocessor socket.
- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor, 1024x768 resolution, with 16 bit VGA card with 512K.
- ✓ Clock calendar, parallel port, and two serial ports. (Game port included on color systems)
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 available.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add \$99.
- ✓ Compatible with DOS, OS/2, Windows, Xenix and Novell.
- ✓ FCC Class B approved.

System Price	65mb	80mb	100mb	200mb
Monochrome	\$1,699	\$1,829	\$1,899	\$2,299
VGA Color	\$1,999	\$2,129	\$2,199	\$2,599
VGA 1024	\$2,199	\$2,229	\$2,299	\$2,699

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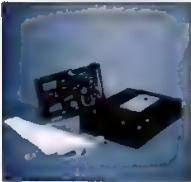
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CP3208 200mb IDE 25ms	849



Mitsubishi 60mb AT Kit

\$349 RLL encoding, 1:1 controller, and 22ms access time make this a quick performer. The perfect upgrade for your 286 or 386 compatibles, this kit comes with everything you need including controller and cables.

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NEC CDR-3501 External CD-ROM Drive	399
Plus Development	
HardCard IIXL 50 - 52mb 9 ms 16bit	399
HardCard IIXL 105 - 105mb 9 ms 16bit	679
Impulse 42mb 12 ms 16bit IDE Kit	399
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Toshiba 1.44mb Floppy Drive

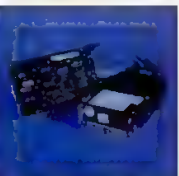
Complete with mounting brackets and installation instructions, this Toshiba works in all true 286 & 386 compatibles. Will also read/write/format 720K 3.5" disks. Rails, add \$5.



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WD1006V-MM2 MFM AT 1:1 Controller	79
WD1006V-SR2 RLL AT 1:1 Controller	89
WE1007V-S2 ESDI AT 1:1 Controller	149



Panasonic Super VGA

\$439 The Panasonic C1381 will do VGA up to 1024x768 interlaced resolution. It has a dot pitch of .28 and is compatible with all standard VGA cards. Includes swivel base and VGA cable.

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Artisoft LanTastic	
LanTastic 2mbps Starter Kit - Two Station	369
LanTastic 2mbps Adaptor	169
LanTastic Ethernet Starter Kit - Two Station	499
LanTastic Ethernet Adaptor	239



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New and improved, the ATI VGA WONDER+ is faster than VRAM. It does interlaced and non-interlaced 1024x768 modes, is 100% register compatible, and comes with extensive software drivers. A free mouse is included as an added bonus. 512K version \$219.

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VGA Wonder + 256K	189
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Everex	
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2400B Int Modem	99
EGA 480 Card	79
RAM3000 16 bit RAM card	75
RAM8000 16 bit RAM card	169
Hercules Graphic Card +	169
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8087-2	115
287XL Faster than the 80287-10	199
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387-SX16	319
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Tiny Turbo Xtra	267
Paradise	
Basic VGA - 8 bit	109
VGA 1024 256K/512K	175 199

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This external modem features V.42 and MNP error correction combined with MNP/5 and V.42 bis data compression to provide total high speed throughput. The PM9600SA is also V.32 TCM, V.32, V.22 compliant and comes with a five year guarantee too.



Practical Peripherals

1200B Int Modem	59
2400B Int Modem	125
2400B Int with MNP	169
PM9600SA Ext. V.32/V.42bis	449
Prometheus	
Promodem 1200B Internal	48
Promodem 2400B Internal	98
Promodem 2400G External	149
Tiara Networking	
Lancard/A PC (Arcnet)	75
Lancard/E Star 8 (Ethernet)	139
Lancard/E AT (16 bit Ethernet)	249
USRobotics	
2400 Baud Internal	119
2400 Baud External	147
Courier HST 14,400 Ext.	579
Courier HST 14,400 Int.	539
Video 7	
VGA 1024i 256K	179
VGA 1024i 512K	209
Vega VGA	149
V-RAM VGA 512K	299

FastData 286/12 \$799

Imagine a fast 286 computer at a super price and you've got the FastData 286/12. This system is complete, not stripped. You get one megabyte of zero-wait-state memory and a 28ms IDE hard disk - standard. Also included is an amber monitor and graphics card, your choice of a high density 1.2mb or 1.44mb floppy drive and a Keytronic keyboard. And since it's a FastData, you are backed with toll-free technical support, one year warranty with the FastShip replacement program & on-site service plan, and our 30 day full money back satisfaction guarantee!

- ✓ 12mhz 80286 processor.
- ✓ 1 megabyte RAM.
- ✓ 40 mb 28ms hard disk 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive
- ✓ Standard chassis (shown with optional chassis - \$50)
- ✓ Five drive bays.
- ✓ 200 watt power supply.
- ✓ 287XL coprocessor socket
- ✓ Monochrome monitor with monochrome graphic board.
- ✓ Clock calendar, parallel port, and two serial ports.
- ✓ Keytronic enhanced 101 keyboard.
- ✓ 8 expansion slots, 6 available.
- ✓ Full documentation.
- ✓ FCC Class B approved.

System Price	40mb	65mb	80mb	110mb
Monochrome	\$799	\$899	\$999	\$1099
VGA Color	\$899	\$999	\$1099	\$1199
VGA 1024	\$999	\$1099	\$1199	\$1299

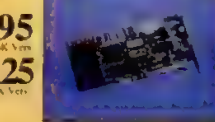
MONITORS

Mitsubishi	
1410 EGA	325
Diamond Scan 1381	479
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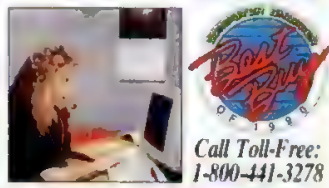
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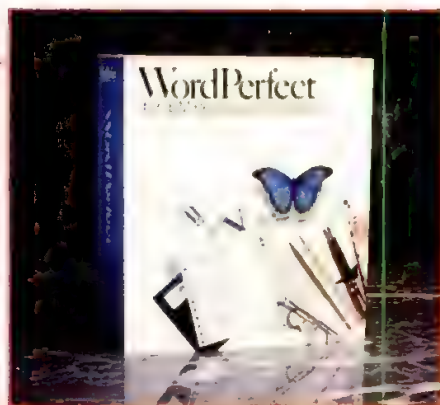
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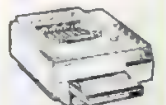
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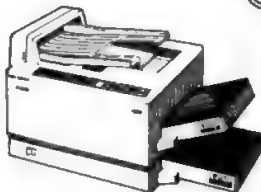
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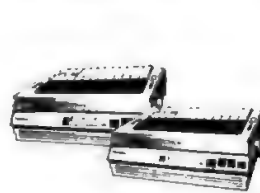


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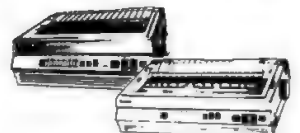
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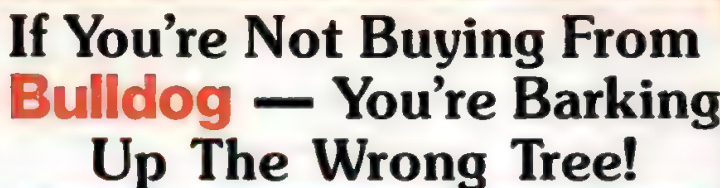
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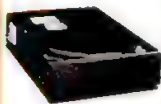


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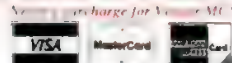
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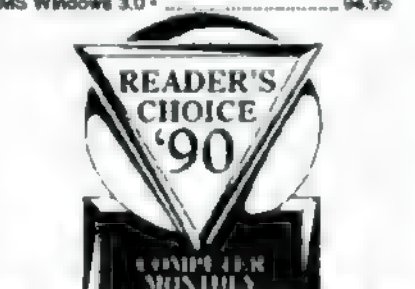
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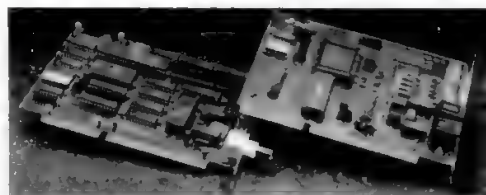
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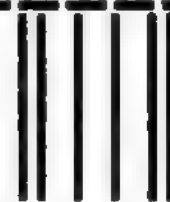
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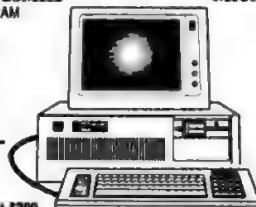
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Source: Beta Research Study, 1988
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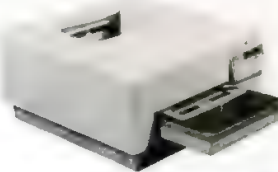
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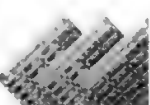
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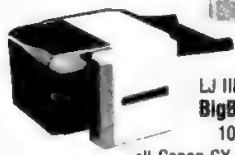


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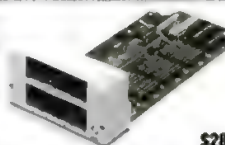
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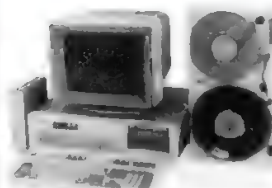
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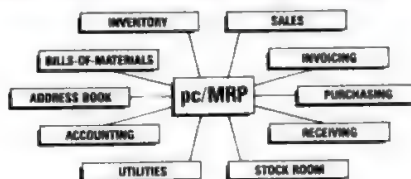
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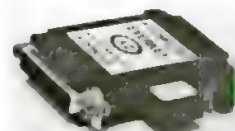
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COMING UP

■ **WINDOWS 3.0:
SPECIAL SECTION**

In this special four-part section, *PC Magazine* shows you how to get the most out of *Microsoft Windows 3.0*.

POWER TIPS FOR WINDOWS USERS

Our *Windows* experts pick up where the *Microsoft* manuals leave off, presenting over 40 hints, tips, and tricks to help *Windows* users untangle the confusion of configuring and optimizing the environment.

WINDOWS 3.0 UTILITIES

You'll find a little of everything in this review of *Windows 3.0* utilities, from phone dialers and calendars to program managers, file managers, and screen expanders.

VIDEO PERFORMANCE

After you've bought enough memory, the smartest hardware investment you can make with *Windows 3.0* is choosing the right video card. *PC Labs* explores the role video plays in the operating environment and shows you how a dozen of the best-selling graphics adapters perform.

3270-TO-PC CONNECTIONS

The *LAN Labs* crew examines 3270 mainframe terminal adapters running under *Windows* and sees things they've never seen before!

■ **THE LATEST PS/2
MODELS**

PC Labs takes an in-depth look at IBM's latest pair of PS/2s, the 486-based Models 90 and 95. We'll show you how the desktop Model 90 and the server Model 95 stack up against their 386 and 486 competitors. And we'll examine the new system design IBM has implemented.

■ **ENDURANCE TESTS:
GRAPHICS**

Look for the results of our months-long look at a variety of graphics hardware products that have a wide impact across a number of applications, from CAD to desktop publishing and beyond. ■

After Hours

Products for the Leisure Side of Personal Computing

Air Warrior: Dogfights On-line Against All Comers

ON-LINE SERVICES
by Tom Mosteller

Air combat flight simulators have always been among the most popular PC games. These programs have evolved from crude affairs with poor graphics and little control over your craft, to the point where the best of them, like Microprose's *F-19 Stealth Fighter*, almost make you airsick. Even the most realistic simulators, however, share one important limitation: You're always pitted against a computerized opponent instead of the human variety.

Sure, the latest version of Microsoft's *Flight Simulator* lets you use your modem to dial up a friend's computer and see him as you fly alongside. Unfortunately, your interaction is limited to looking at your friend as he passes serenely by. If only you could shoot at him!

Well, the folks at Kesmai have teamed up with GE Information Services' GENie, an on-line service that allows you to do just that. Their new *Air Warrior* on-line game allows you to test your skills against dozens of live opponents just waiting for you to show up and make their collective day.

NOT YOUR USUAL GAME

Air Warrior works differently from most other PC games. The first difference is that you don't walk into a computer store and buy it. Instead, you download three files from GENie: AIRWAR.EXE, AIRWAR.DAT, and TERRAIN.DAT. Total time: about 45 minutes at 2,400 bits per second, which at the \$6 per hour off-peak rate costs a bargain—basement \$4.

The second difference is that the actual flight simulator software runs locally, on your PC,

while another component runs on GENie's mainframes, keeping track of the battlefield and the other players. *Air Warrior* is currently available for IBM-standard, Macintosh, Atari ST, and Amiga computers. The Kesmai programmers have gone to great lengths to ensure that none of the computer types have an unfair advantage over any of the others. Finally, here's your chance to wipe that smirk off the face of your neighbor the Mac owner.

The local/mainframe arrangement allows you to practice on your PC, for free, to learn the mechanics of flying. This is a real money saver, because *Air Warrior* is a tough program to master. Plan to spend at least a few hours learning to fly in the local mode. You may want to start with the more forgiving World War I planes before graduating to the high-performance Second World War and Korean War fighters or the cumbersome bombers. Once your skills have improved to the point where you can take off, cruise at 5,000 feet, fly a level circle around a mountain,

and safely land at the airfield you started from, you're ready to join the on-line excitement.

The program supports either a mouse or joystick, but I recommend the mouse, as it seems to give a much better feeling of control. It's also a good idea to dig out the mouse's documentation and figure out how to turn down its sensitivity, because at high sensitivity levels, your plane can become very touchy and difficult to control.

ON-LINE SERVICES

Air Warrior puts multiplayer combat on-line.

GAMES

Stormovik: Air power in the post-Cold War world

Countdown

Escape before you lose your mind.

LEARN YOUR CRAFT, OR ELSE...

The next phase is training. Now you're on-line, with the meter running, competing against both live and computer-driven foes. You are initially assigned to one of three countries; later, you can switch allegiance at will. Unless you've mastered the basic skills of flying, you'll be dead meat in short order, but fortunately your performance here does not count toward your score in the big game. Find the computer drones, and practice shooting them down. Then you can graduate to the task of finding and engaging the other human players in the training area—a much more demanding task!

When you've mastered the art of smoking off your rivals in the practice field, you're ready for the actual war. Now you must be able to do more than fly well on your own. You must learn to be part of a team and join together to complete a mission. There are varied mission scenarios available on-line; to join one of these, you meet your teammates in a briefing room and plan the mission along with them. Missions can be very complex, involving several bombers and supporting fighters, or as simple as two players

CONTINUES



Air Warrior's graphics aren't quite up to the standards set by state-of-the-art simulators such as Microsoft's *Flight Simulator*.

After Hours

GENie

CONTINUED

saying "Let's go get the other airfield!"

All of this scene-setting would be wasted if the actual game quality wasn't there. On this score, *Air Warrior* earns mixed reviews. The images of planes are rather simple compared to state-of-the-art games like *Flight Simulator* or Lucasfilm's *Battle of Britain*. If you don't like the way your plane looks, however, you can draw your own using a paint program, or download one from the GENie library files.

In some respects, the software has an unfinished feel to it. During the course of play, I was dropped off-line several times. This is a real pain when you've just sneaked up on an enemy and are about to blast him back to his ancestors. There were also some unnecessary problems in setting up and getting on-line. For instance, the default communications format is set up for 8 bits, no parity, a strange choice when you consider that all GENie nodes are 7 bits, even parity! Further, there's no way to set up a log-on macro; you need to type in your password every time. If you've ever seen GENie passwords, you know what an annoyance this

can be. These are minor points, but they do detract from the enjoyment of the game.

THE HEAT OF THE BATTLE

When it comes to raw combat—the real reason you're here in the first place—*Air Warrior* excels. The human element overcomes any minor game limitations, resulting in life and death dogfights which leave you dripping with sweat. After some intense action, I ended up with an aching hand from gripping the mouse so tightly!

This excitement is available to almost all home PC players, regardless of the type of equipment they use or its level of sophistication. A turbo XT, CGA monitor, and 1,200-bps modem are enough to join the fray on equal terms. Better setups give a nicer appearance, but afford no real competitive advantage. A color monitor is almost a necessity, however; it's the key to distinguishing friend from foe. In the heart of an intense dogfight, this clue helps you figure out who's on your side and who isn't



Air Warrior's radar screen helps you keep tabs on both friendly and hostile combatants in the heat of a dogfight.

in the fleeting seconds you have to line up a kill.

Keep in mind while you're playing that the cost of the equipment isn't the barrier to using *Air Warrior*—it's the cost of the time. The game is not among the services offered by GENie at the \$4.95 per month Star*Services rate; you'll pay \$6 per hour to fly the unfriendly skies. In these days of budgetary restraint and government program cutbacks, the cost of *Air Warrior* adds a dose of unintended realism. Frequent play will leave you with a GENie bill that looks like the Pentagon

budget. Just as with real air forces, it's not only skill but also money which limits what can be done. Maybe the people you're defending should shoulder part of the bill...

List Price: To download necessary files from GENie, approximately \$4 at 2,400 bps. Connect time charges apply, at \$6 per hour, off-peak.

Requires: 512K RAM, graphics monitor, modem. GENie, GE Information Services, 401 N. Washington St., Rockville, MD 20850; (800) 638-9636.

CIRCLE 404 ON READER SERVICE CARD

Stormovik Takes Air Combat Past The Cold War

GAMES
by Tom Unger

It's 1991 and peace has broken out all over Europe; the Cold War is *kaput*. Lenin has been tossed on the scrap heap of history, and our guns are being swapped for butter. Yet in the world of *Stormovik*, Electronic Arts' latest offering (\$79.95), the danger to the new world order has never been greater. Renegade military terrorists have infiltrated the armies of the NATO Alliance and the Warsaw Pact, and are using their stolen planes and guns to threaten the fragile political balance. On the terror-

ists' agenda: hostage taking, surprise attack, and political assassination.

Your place in this chilling scenario is in the cockpit of the Soviet Union's most powerful ground attack aircraft, the Sukhoi SU-25 *Stormovik*—code name FrogFoot. Those of you familiar with Electronic Arts' *LHX Attack Chopper* will remember the FrogFoot as the nearly indestructible Soviet attack jet that caused you to abort more missions than you care to admit. But tough as your *Stormovik* is, you'll find your plane pitted against even tougher hardware. That includes the best from both the United

States and the Soviet Union: F-16 Falcons, A-10 Thunderbolts, Mig-27s and 29s, a host of jet-killing helicopters and, most frighteningly, radar-evading American F-117 Stealth Fighters. Most of these planes can outaccelerate, outrun, or outmaneuver you. At the same time, ground-based armor will pound relentlessly at your titanium-reinforced fuselage.

How to survive and complete your mission against such appalling odds? Skimming along at nearly 700 miles per hour only 30 feet off the ground might keep even the best pilot busy, but you'll have other things to worry about. On your side you have your wits, your skill as one of the pilots of the elite Soviet Red Guard Strike force, and the large-

est array of firepower ever assembled under the wings of a single attack aircraft. That overwhelming firepower may just be the factor that decides your fate, should you be wily enough to survive in combat for any length of time with five or six attacking aircraft.

REALITY BREAK

Life for an elite Soviet pilot in the world according to *Stormovik* isn't fundamentally different from life for a typical Soviet. Those with higher rank get the best bread, the best meat, and the best clothes. Those lower on the totem pole are lucky to get anything at all. When you enlist in the *Stormovik* strike force as a lowly junior lieutenant, you'll

CONTINUES

The face behind the name.

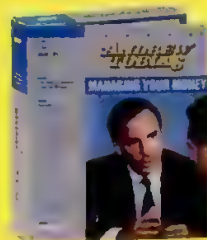
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After Hours

Electronic Arts

CONTINUED

get only second-rate weapons, and fewer of them. As a full colonel, however, you're entitled to better munitions. You'll choose from among generous stockpiles of the fastest guided missiles, the most powerful rockets, and the most accurate bombs.

As you might guess, successful missions bring promotions and perks: the use of an automobile, a box of chocolates for your wife, two pairs of American blue jeans, a tin of beluga caviar. This sort of attention to detail reveals not only Electronic Arts' commitment to building a complete world in its games, but also EA's emphasis on a trait not usually found in military simulations: a sense of humor. You'll find EA's tongue planted firmly in cheek when you choose *Stormovik's*

lation in March of 1991 and you may be asked to fly over and photograph a new NATO hanger—a suspected breach of an arms reduction treaty. Start your mission two years later at the other end of *Stormovik's* time scale, and you may be required to attack a Stealth Fighter air base that has been taken over by terrorists.

SAVING GRACE

If you're neither successful at your mission nor fast enough to eject from your plane before it becomes a burning wreck, the game automatically saves your most recent rank and score—a capability we wish had been offered in earlier Electronic Arts simulations like *688 Attack Sub* and *LHX Attack Chopper*. *Stormovik*, to its credit, also allows you to easily change pilots, scenarios, armaments, and missions. Those who found *LHX* nearly impossible to play at its higher levels will be relieved to dis-



Stormovik's VGA graphics are more realistic and detailed than those of previous simulations from Electronic Arts.

pace, and even in the wildest combat with five or six planes whizzing around you (not to mention a storm of cannon and missile fire), the action remains smooth and seamless.

The SU-25's control panel is pleasingly low-tech, too. The plane itself, originally designed in the 1960s and improved periodically ever since to become the fire-breathing monster it is today, lacks the fancy electronic gizmos to be found in comparable American fighter and helicopter simulators.

These individual successes combine to make *Stormovik* a great success. Clearly, the folks

at Electronic Arts have done their homework and bucked the conventional wisdom in the process of creating the first combat simulator to put you at the yoke of a Russian attack aircraft. The fruit of their efforts is a first-class simulation that is as slyly educational as it is white-knuckle exciting.

List Price: *Stormovik*, \$79.95.

Requires: 512K RAM; CGA, EGA, MCGA 256-color graphics; DOS 2.10 or later. Copy protected through documentation. Electronic Arts, P.O. Box 7578, San Mateo, CA 94404-7578; (415) 572-2787.

CIRCLE 406 ON READER SERVICE CARD



The control panel of your SU-25 lacks some of the complex instrumentation that complicates other simulators.

practice mission; a Russian designer proclaims this flight simulator to be the first of its kind anywhere.

Stormovik is notable not only for its realistic military aspects but also for the flexibility of its overall game scenario. While you can start at the bottom of the military ladder and work your way up, you can also start at any of a dozen ranks. In addition, you can play your missions at different levels of political and military tension. Start your simu-

cover that—unlike in real combat—one careless mistake won't always knock you completely out of the war.

In other significant regards, the simulator surpasses its predecessors. The graphics here, especially in VGA mode, are richer than before. Mountains and buildings tend to appear more realistically on the horizon, instead of coming into view only when they are just meters from you. On a fast 80386-based PC, the game moves along at a brisk

New Access Game Traps You in a Mental Institution



It's everyone's worst nightmare. You're a captive in an asylum in a foreign country because you know too much...but you can't remember what it is you're supposed to know.

That's how *Countdown*, Access Software's new adventure game, begins. If you are successful, it ends with your saving the world from the Black December terrorist organization. Along the way there are lots of puzzles to solve, striking graphics, and Access's famous "RealSound®" digital sound effects.

FIRST THINGS FIRST

The first objective, of course, is to get out of your squalid cell. That's accomplished by bribing the brainless attendant (who seems to be a budding entomologist) with a rare insect you find in your room. The attendant then brings you a tray of inedible swill along with a knife (Ah ha!) which you use to pry open the bars on the window (yes!), from which you can creep along a high ledge to an unlocked window (yes! yes!). From the unlocked window you gain entrance to a hall, where a guard catches you (oops!!) and rushes you to an op-

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After Hours

Access Software

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erating theater where a lobotomy is quickly performed (ouch!), ending both your useful life and your chance to solve *Countdown*.

The above sequence highlights one of the few disappointments I had in playing *Countdown*. If you pick up the bug in your cell, you get stung but don't suffer any ill effects. Nor can you stumble off of the building's ledge to your death. What kind of wimpy adventure protects you from venomous insects and

keeps you from falling 300 feet to a splatery demise? There just aren't as many ways to die in *Countdown* as I'd like. The most exciting way to go is at the claws of the tiger who lurks in the pit you tumble into when the rope holding your feet burns in two. In living VGA, this mistake leads to an unforgettable and colorful demise.

Although it supports both keyboard and joystick, *Countdown* should be played with a mouse. You simply click on a verb (look, open, move, etc.) listed at the bottom of the screen and then click on the object of the verb. For example, to open a door, click on "open" and then move the mouse cursor to the door and click there. It's a smooth, intuitive and typing-free interface.

SIGHTS AND SOUNDS

Countdown is a VGA-only game (if you've got CGA or EGA, don't buy it) that uses 256 colors to paint photographic-like images; when combined with motion, the effect is close to cinema

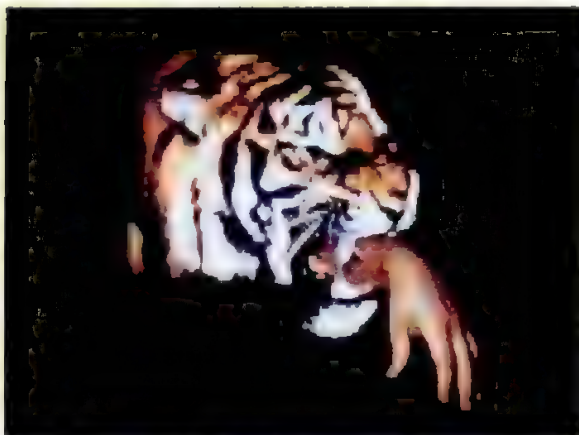
quality. Background sounds such as a growling tiger, talking parrot, and the clickety-clack of the Orient Express add to the realism. And since the sounds are produced by Access's ingenious "RealSound®" system, you don't need any special equipment to hear them.

There are 50 rooms to explore, and so many puzzles and situations to solve that *Countdown* will keep you entertained for hours and hours. Indeed, the developers claim that the most quickly anyone has completed the adventure is 22 hours, with 30 to 35 hours being typical for most gamers. As for me, it looks like I'll grow old in the asylum trying to figure out the combination to the stupid wine bottles.

List Price: *Countdown*, \$59.95.

Requires: VGA or MCGA, 640K RAM, DOS 2.0 or later. Hard disk, mouse and 8 MHz or faster CPU recommended. Access Software, 545 W. 6500 South, #130, Bountiful, UT 84010; (800) 800-4880.

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and select" customer and product lookup all help to make the program almost intuitively easy to use. All transactions are performed from just one Work Screen. Yet it incorporates many of the features you'd expect to find only in systems costing hundreds of dollars more, features like:

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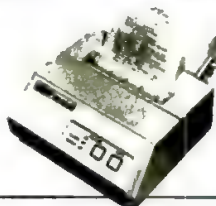
—G. Truglia, Car-Tune, New City, NY

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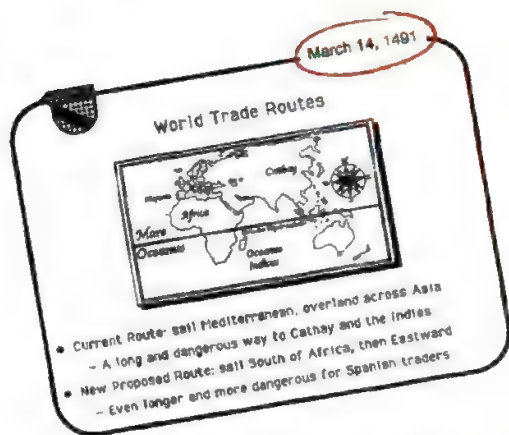


PCM212

by
Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing



A sample file included with the **Microsoft PowerPoint** presentation graphics program purportedly illustrates Columbus's presentation to Ferdinand and Isabella, requesting financing for his voyage west. But (picky, picky) an eagle-eyed reader says Australia and New Zealand weren't discovered and mapped by Europeans until the 17th and 18th centuries, respectively, and the accurate rendition of eastern Asia is equally prescient.

Standard Feature on the Government Version

"If the [laser printer's page] orientation is changed from portrait to landscape, the maximum number of lies per page is changed accordingly."

Brother HL-8e Laser Printer User's Guide

NEWS FLASH:

Viruses affect hardware, too? Not quite. The story in the Albany, NY, *Times-Union* explains it a bit better than the headline did: It wasn't the computer or the modem that was infected. Rather, the virus was in communications software bundled with the computer and modem.

New computers come with own virus

One company said 200 of its modems were infected

In one decision earlier this year, workers at Swedish firm... company were surprised when its computers suddenly began flashing the message...



Maybe the second session can be used for a grammar checker? Flyer from TriLogic, Canonsburg, Pennsylvania, a Digital Equipment Corp. distributor.



New Math

"As Microsoft Office for Windows, the [three] bundled programs [Word for Windows, Excel, PowerPoint] cost \$995—\$46 more than the Mac version, but about two-thirds less than buying the \$495 programs separately."

InfoWorld, October 1, 1990 (purchased together, the three programs cost one-third less, exactly)

If your entry is used in *Abort, Retry, Fail?* we'll send you \$50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of entry are considered. Winners this issue: Park Chamberlain (Microsoft changes history), R.G. Carter (Duel sessions), Michael M. Felack (lies per page), Anthony T. Salvarezza (modem has virus), Daniel Raisch (Office for Windows).

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1. Which products are you most interested in?

- ☐ 286-based systems ☐ UNIX*-based systems
☐ 386-based systems ☐ Laptops
☐ 386SX-based systems ☐ Other: _____
☐ 486-based systems

2. Are you interested in computer products for:

- ☐ Home ☐ Business ☐ Resale

3. How many PCs does your company plan to purchase in the next twelve months?

<u>Quantity</u> <u>Timeframe</u>	<u>Quantity</u> <u>Timeframe</u>
_____ Less than 1 month	_____ 6-12 months
_____ 1-3 months	_____ More than 12 months
_____ 3-6 months	

4. What do you plan to use computer products for?

5. How many PCs do you have installed now at your company?

6. Are you interested in leasing? ☐ Yes ☐ No

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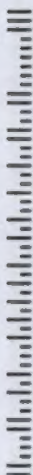
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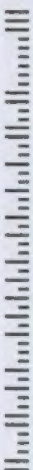
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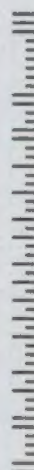
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